तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ BU/ACAD/2017/3223-3229.

दिनाँक 16/09/2017

The Minutes of Meeting of BOS

In reference to the BOS of department of Mechanical Engineering ....., Institute of ...Engineering & Technology ..... held on 16/09/2017 regarding the revision of syllabus in tune with CBCS/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

HOD/Coordinator

Coordinator
Deptt. of Mechanical Engineering
I.E.T., Bundelkhand University, Jhansi

विभाग Mechanical Engg
BU/IET/MD
/2020-18

Date: 15/12/2020

Hon'ble Vice Chancellor Sir
Bundelkhand University, Jhansi

Subject: **Approval for board of studies (BOS) meeting for academic session 2020-2021 on dated 18/12/2020**

Respected Sir,

Department of Mechanical engineering, IET, BU want to conduct BOS meeting of academic session 2020-2021.

The agenda of the meeting are:

1. Internal/External examiner panel
2. Revision of syllabus and open elective-I, Departmental Elective-I, II, III, IV.
3. To modify CBCS of VII and VIII semester, 2017-2018 session,
4. To modify CBCS of V, VI, VII, VIII semester, 2018-2019 session,
5. To modify CBCS of III, IV, V, VI, VII, VIII semester, 2019-2020 session,
6. To modify CBCS of III, IV, V, VI, VII, VIII semester, 2020-2021 session.

List of members for BOS is as follows:

1. Prof S.K. Katiyar, Dean Engineering, IET, BU, Jhansi
2. Er. Brajendra Shukla, Academic Coordinator, IET, BU, Jhansi
3. Er. Vishal Arya, Asst. Prof. Coordinator & Convenor B.O.S, MED
4. Er. Jitendra Verma, Asst. Prof. & Member B.O.S , MED
5. Er. Rahul Shukla, Asst. Prof. & Member B.O.S, MED

Submitted for your kind approval.

With Regards,

15/12/2020.

(Er. Vishal Arya)
Asst. Prof. & Coordinator
Deptt. of Mechanical Engg.
IET-BU, Jhansi.

Project Director / Dean Engg.
Permission may be granted
to conduct BOS on 18/12/2020.
15/12/2020

Approved
15/12/2020

15/12

Institute of Engineering & Technology
Bundelkhand University Jhansi U.P.-284128

Ordinance

For

Undergraduate Course

(B. Tech.)

On

Choice Based Credit System

(Effective from the Session: 2017-18)

Institute of Engineering & Technology
Bundelkhand University Jhansi U.P.-284128.

CHOICE BASED CREDIT SYSTEM (CBCS) ORDINANCE GOVERNING THE DEGREE OF BACHELOR OF TECHNOLOGY (B.Tech.)

CHOICE BASED CREDIT SYSTEM (CBCS):

The choice based credit system provides flexibility in designing curriculum and assigning credits based on the course content and hour of teaching. The choice based credit system provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective and open elective courses .The CBCS provides a cafeteria type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquired more than the required credits, and adopt an interdisciplinary approach to learning. The courses shall be evaluated on the grading system, which is considered to be better than the conventional marks system. It is necessary to introduce the grading system to make the uniformity among all technical institutions of India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the AICTE has formulated the guidelines to be followed.

DEFINITIONS OF KEY WORDS:

(i) **University: Bundelkhand University Jhansi U.P. 284128**

(ii) **Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.**

(iii) **Semester: Each semester will consist of 15-20 weeks of academic work equivalent to 90 actual working days. The odd semester may be scheduled from July to December and even semester from January to June.**

(iv) **Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses *(core, elective and Foundation Courses etc)*.**

(v) **Credit Based Semester System (CBSS): Under the CBSS, the requirement for awarding a degree is prescribed in terms of number of credits to be earned by the students.**

(vi) **Programme: B.Tech. educational programme leading to award of a Technical Degree.**

(vii) **Course: Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weightage. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.**

(viii) Branch: discipline of B.Tech. Degree Programme (Biotechnology Engineering/Biomedical Engineering /Computer Science & Engineering/Electronics & Communication Engineering /Electronics & Instrumentation Engineering / Food Technology /Mechanical Engineering)

(ix) **Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters A,B,C,D,E and F**

(x) **Grade Point: It is a numerical weightage allotted to each letter grade on a 10-point scale.**

(xi) **Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.**

(xii) **Credit Point: It is the product of grade point and number of credits for a course.**

(xiii) **Semester Grade Point Average (SGPA): It is a measure of academic performance of student/s in a semester. It is the ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed as round off to two decimal places.**

(xiv) **Cumulative Grade Point Average (CGPA): It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points earned by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed as round off to two decimal places.**

(xv) **Transcript or Grade Card or Certificate: Based on the grades earned, a grade sheet/certificate shall be issued on demand to the registered student at the end of every academic year. The grade sheet/certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of both semesters and CGPA earned till that academic year.**

1. ADMISSION

Admission to B.Tech first year in I semester and lateral admission in B.Tech. II year will be made as per the rules prescribed by the Academic Council of the Bundelkhand University Jhansi.

1.1. ELIGIBILITY FOR ADMISSIONS

(a) Admission to B. Tech. First Year as per Bundelkhand University Norms which is generally based on AICTE and according to the latest U.P. Government notifications/rules.

S.No.	Branch	Approved Seats	Eligibility Criteria for admission
1.	B.Tech.(Biotechnology Engineering)	60	10+2 with Physics, Chemistry, Biology/Mathematics/Biotechnology with minimum 50% marks in aggregate
2.	B.Tech.(Biomedical Engineering)	60	10+2 with Physics ,Chemistry and Mathematics with minimum 50% marks in aggregate
3.	B.Tech. (Computer Science & Engineering)	60	
4.	B.Tech. (Electronics & Communication)	60	
5.	B.Tech. (Electronics &Instrumentation Engineering	60	
6	B.Tech. (Food Technology)	60	
7.	B.Tech. (Mechanical Engineering)	60	

(b) Admission to B.Tech. Second Year through Lateral Entry Scheme:

Candidates who have passed 3/4 year Diploma (with minimum 60% marks) from institutions recognized by the U.P. Board of Technical Education in any branch of Engineering/Technology are eligible for admission to Second year in any branch of Engineering./Technology

2. DURATION OF COURSES

Minimum duration of the B.Tech. course shall be four (04) years.

2.1 The student admitted to B.Tech First year shall complete the course within a period of Eight (08) academic years from the date of first admission, failing which he/she has to discontinue the course.

2.2 The student admitted to lateral entry scheme (2nd year B.Tech.) shall complete the course within a period of six academic years from the date of first admission, failing which he/she has to discontinue the course.

3. CURRICULUM

3.1 The 4 year curriculum has been divided into 8 semesters and shall include lectures, tutorials, practicals, seminars and projects etc. in addition to industrial training and educational tour etc. as defined in the scheme and executive instructions issued by the University from time to time.

3.2 The curriculum will also include such other curricular, co -curricular and extracurricular activities as may be prescribed by the University from time to time.

3.3 There will be four types of courses.

(i) Foundation Courses (Basic science / Engineering science / Humanities / Social science): The Foundation Courses are of two kinds: *Compulsory Foundation* and *Elective foundation*.

"Compulsory Foundation": These courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines.

"Foundation Electives": These are value based courses aimed at man making education.

(ii) Core Courses: This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirements of a program in a said discipline of study.

(iii) Elective Courses: This is course, which can be chosen from the pool of papers. It may be supportive to the discipline/ providing extended scope/enabling an exposure to some other discipline / domain / nurturing student proficiency skills.

(iv) Mandatory Courses: These courses are mandatory for students joining B.Tech. Program and students have to successfully complete these courses before the completion of degree.

4. CHANGE OF BRANCH

Change of branch may be allowed against the vacant seats in the second year, on the basis of merit at the B.Tech. First year examination for those who are passing without any carry over paper. The change of branch if allowed will become effective from B.Tech. IIIrd semester.

5. EXAMINATION

5.1. ATTENDANCE

Every student is required to attend all the lectures, tutorials, practicals and other prescribed curricular and co-curricular activities.

75 % attendance is compulsory to appear into the semester / sessional examinations.

Relaxation will be given as per university norms.

5.2 The performance of a student in a semester shall be evaluated through continuous class assessment and end semester examination. The continuous assessment shall be based on class tests, assignments/tutorials, quizzes/viva-voce and attendance. The marks for continuous assessment (Sessional marks) shall be awarded at the end of the semester. The end semester examination shall be comprised of written papers, practicals and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

5.3 The distribution of marks for sessional, end semester theory papers, practicals and other examinations, seminar, project and industrial training shall be as prescribed. The practicals, viva-voce, projects and reports shall be examined/evaluated through internal and external examiners as and when required.

5.4 The marks obtained in a subject shall consist of marks allotted in end semester theory paper and sessional work.

5.5 The total credit requirement for B.Tech. degree is 200. The Credit distribution over the semesters is listed below.

S.No	Semester	Credit
1.	I	26
2.	II	26
3.	III	24
4.	IV	24
5.	V	24
6.	VI	24
7.	VII	26
8.	VIII	26

5.6 Duration of Theory Examination: 03 hours for 100 marks papers.
02 hours for 50 marks papers.

5.7 The End Semester Theory examination pattern is based on Bundelkhand University Norms.

5.8 End Semester examination shall be conducted by the University according to academic calendar. The question paper will be set by the examiners appointed by the Vice Chancellor based on the recommendation of the Departmental Board of Studies.

5.9 Practical examination will be conducted by the External and Internal examiners appointed by the Vice Chancellor on the recommendation of the Departmental Board of studies.

5.10 The subject teacher shall conduct sessional examination for each subject. The question will be objective /short answers/long answers type. Two sessional examinations are to be conducted for any given subjects by the respective subject teacher. If any student does not appear in the sessional examination, he /she can be allowed for makeup sessional by the permission of respective Head of the Department / Coordinator and Dean /Director of the Faculty of Engineering

5.11 The Institute will conduct special back paper examination only for final year students.

5.12 The candidate who fails in sessional or practical examination (internal & external) can appear in the same after obtaining the permission of subject teacher on the recommendation of the Head / Coordinator Dean /Director of the Faculty of Engineering after depositing the prescribed fee laid down by University.

5.13 Scrutiny & Revaluation of theory papers is permitted as per University Norms.
5.14 Cases of unfair means shall be dealt as per the rules and regulations of the University.

6. ELIGIBILITY OF PASSING IN SEMESTER EXAMINATION

A student who obtained Grades A^+ to E shall be considered as passed. If a student secured "F" grade, he /she has to reappear for the examination. It is mandatory for a student to earn the required credits as mentioned in each semester.

(a) For a pass in a Theory Subject/Practical examination, a student shall secure minimum of 40% of the maximum marks or E Grade prescribed in the end semester Examination And 40% of maximum marks or E grade in Sessionals / Internals.

(b)The students who do not satisfy the condition above mentioned 6.2(a) or the student who remains absent shall be deemed to have failed in that subject and may reappear for same semester subsequent examinations after depositing the prescribed examination fee as laid down by University.

7. ELIGIBILITY FOR PROMOTION

For the promotion of the students to the successive year the rule is given below in table 1.

TABLE 1

For promotion to year	Minimum permitted credits for promotion		
	1st Year (I+II semesters)	2nd year (III +IV semesters)	3rd year (V+VI semesters)
II	30	-	-
III	42	28	-
IV	52	40	28

8. AWARD OF DEGREE -

8.1 A student shall be declared to have completed the program of B.Tech. Degree, if he/she earned all 200 Credits.

8.2 A candidate has to obtain at least E grade in each semester for the award of the degree.

8.3 The result of the semester shall be declared pass only on securing E or above grades in all subjects and minimum Semester Grade Point Average (SGPA) is 4.0.

Level	Outstanding	Excellent	Very Good	Good	Above Average	Average	Poor	Fail
Letter Grade	A^+	A	B^+	B	C	D	E	F
Grade Points	10	9	8	7	6	5	4	00
Score (Marks) Range (%)	≥ 90 (90-100)	<90 (80-89)	<80, ≥70 (70-79)	<70, ≥60 (60-69)	<60 ,≥50 (50-59)	<50, ≥45 (45-49)	<45, ≥40 (40-44)	< 40 (0-39)

8.4 Computation of SGPA and CGPA

The following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

(a) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci$$

where C_i is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

(b) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \Sigma(Ci \times Si) / \Sigma\ Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

(c) The SGPA and CGPA shall be rounded off to 2 decimal places and reported in the transcripts.

ILLUSTRATION : Ist Semester without back

S.No.	Course	Credit	Grade Letter	Grade Point	Credit Point
1.	*MA-202/ 1856	4	B^+	8	32
2.	1863/ HU-101	3	C	6	18
3.	1857/ PH-201	3	B	7	21
4.	1859/ ME-201	4	A^+	10	40
5.	1861/ CS-201	4	D	4	16
6.	1865/CE-201	4	C	6	24
PRACTICAL/TRAINING/PROJECT					
7.	10874/ HU-251	1	B^+	8	8
8.	10870/ CS-251	1	C	6	6
9.	10872/ CE-251	1	B	7	7
10	10868/ME-251	1	A^+	10	10
		26			182

SGPA = 182/26 = 7.0

Ist semester with back in one paper
In case the candidates fails in one subject then his subsequent SGPA calculation

S.No.	Course	Credit	Grade Letter	Grade Point	Credit Point
1.	*MA-202/ 1856	4	B^+	8	32
2.	1863/ HU-101	3	C	6	18
3.	1857/ PH-201	3	B	7	21
4.	1859/ ME-201	4	A^+	10	40
5.	1861/ CS-201	4	F	0	0
6.	1865/CE-201	4	C	6	24
PRACTICAL/TRAINING/PROJECT					
7.	10874/ HU-251	1	B^+	8	8
8.	10870/ CS-251	1	C	6	6
9.	10872/ CE-251	1	B	7	7
10	10868/ME-251	1	A^+	10	10
		26			166

SGPA = 166/26 = 6.38

In the subsequent attempt suppose the candidate obtained grade E then calculation will go as follows

Course	Credit	Grade Letter	Grade Point	Credit point
1861/CS 201	3	E	4	3x4 = 12

Ci (First Attempt) i.e. 166 + Ci (subsequent attempt) i.e. 12 = 178
Thus, SGPA= 178/26=6.84

IIND SEMESTER

	Course	Credit	Grade Letter	Grade Point	Credit Point
1.	*MA-202/ 1856	4	B^+	8	32
2.	1863/ HU-101	4	C	6	24
3.	1857/ PH-201	3	B	7	21
4.	1859/ ME-201	4	A^+	10	40
5.	1861/ CS-201	4	A	9	36
6.	1865/CE-201	3	C	6	18
PRACTICAL/TRAINING/PROJECT					
7.	20316	1	B^+	8	8
8.	20317	1	C	6	6
9.	20318	1	B	7	7
10.	20319	1	A^+	10	10
		26			202

Thus, SGPA= 202/26=7.7 (round off to two decimal places)

$$\text{CGPA} = \frac{26\times6.84 + 26\times7.7}{52} = 7.27$$

Credit After Final Semester

SEM 1	SEM 2	SEM 3	SEM 4	SEM 5	SEM 6	SEM 7	SEM 8
Credit :26	Credit :26	Credit :24	Credit :24	Credit :24	Credit :24	Credit :26	Credit :26
SGPA:6.84	SGPA:7.27	SGPA:8.1	SGPA:7.34	SGPA:9.1	SGPA:6.38	SGPA:7.34	SGPA:7.9

Thus CGPA =

$$\frac{26\times\ 6.84+\ 26\times\ 7.27+\ 24\times 8.1+\ 24\times 7.34+\ 24\times 9.1+\ 24\times 6.38+26\times 7.34+26\times 7.9}{200}$$

⇨ **CGPA = 7.525**

⇨ **CGPA = 7.53 (Round of to two d3ecimal places)**

(d) CONVERSION OF GRADES INTO PERCENTAGE

Conversion formula for the conversion of CGPA into Percentage is CGPA Earned x 10 = Percentage of marks scored.

Illustration: CGPA Earned 7.53 x 10 = 75.3%

9. CANCELLATION OF ADMISSION

The admission of a student at any stage of study shall be cancelled if:

(a) He / She is not found qualified as per AICTE / State Government norms and guidelines or the eligibility criteria prescribed by the University or
(b) He / She is found unable to complete the course within the stipulated time or
(c) He / She is found involved in creating indiscipline in the Institution or in the University.

Note: The University has the power to amend/change any clause of ordinance of the Institute of Engineering & Technology.

Dean **Expert**

Internal Members **CBCS Committee Member**

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
YEAR I, SEMESTER-I
Common for all branches of B. Tech. (wef 2018-19)

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	MA-1841/ MA*-1842/ BT*-1852/ FT*-1842/ FT*-1852	Maths-I/ Elementary Mathematics-I/ Remedial Biology-I/ Elementary Mathematics/ Elementary Biology	2	1	0	30	20	50	100	150	3
2	ME-1850/CE-1851	Manufacturing Process/ Environment and Ecology**	2	0	0	10	10	20	30	50	2/0
3	PH-1843	Engineering Physics-I	2	0	0	15	10	25	50	75	2
4	CY-1844/ ME-1845	Engineering Chemistry/ Engineering Mechanics	3	0	0	30	20	50	100	150	3
5	EC-1846/ CS-1847	Electrical Engineering/ Computer concepts and programming in C	3/2	0/1	0	30	20	50	100	150	3
6	EC -1848/ HU-1849	Electronics Engineering/ Professional Communication	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	PH-10859/ HU-10860	Physics Lab/ Professional Communication Lab	0	0	2			25	50	75	1
8	CY-10853/ ME-10854	Engineering Chemistry/ Engineering Mechanics Lab.	0	0	2			25	50	75	1
9	WS-10857/ ME-10858	Workshop Practice/ Computer Aided Engg. Graphics Lab..	0	0	2			25	50	75	1
10	EE-10855/ CS-10856	Electrical Engineering Lab/ Computer Programming Lab.	0	0	2			25	50	75	1
11	10861/GP-101	General Proficiency**	-	-	-	-	-	50	-	50	0
		Total	15/14	1/2	8	-	-	-	-	1025/975	20/18

***Note:- Elementary Mathematics-I is for the students who passed 10+2 examination with Biology and Remedial Biology-I is for the students who passed 10+2 with Mathematics (Only for the students of Biotechnology stream). Elementary Mathematics is for the students who passed 10+2 examination with Biology and Elementary Biology is for the students who passed 10+2 with Mathematics (Only for the students of Food Technology stream).**

**** No Credit**

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
YEAR I, SEMESTER-II
Common for all branches of B. Tech. (wef 2018-19)

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	*MA-1855/ 1856 BT*-1866/ FT*-	Maths-II/Elementary Mathematics-II/ Remedial Biology-II/ Engineering Mathematics-I	2	1	0	30	20	50	100	150	3
2	ME-1859/HU-1858	Engg. Mechanics / Engineering Chemistry	3	0	0	30	20	50	100	150	3
3	PH-1857	Engineering Physics-II	2	0	0	15	10	25	50	75	2
4	EE-18/ HU-1863	Electronics Eng./Professional Communication	3	0	0	30	20	50	100	150	3
5	CS-1861/EE-1860	Computer Concepts and Programming in C/Electrical Engg.	2/3	1/0	0	30	20	50	100	150	3
6	CE-1865/ME-1864	Environment and Ecology** /Manufacturing process	2	0	0	10	10	20	30	50	0/2
PRACTICAL/TRAINING/PROJECT											
7	PH-10873/HU-10874	Physics Lab/Professional Communication Lab	0	0	2			25	50	75	1
8	CS-10870/EE-10869	Computer Programming Lab/Electrical Engg. Lab	0	0	2			25	50	75	1
9	CE-10872/WS-10871	Computer Aided Engineering Graphics/Workshop Practice	0	0	2			25	50	75	1
10	ME-10868/CY-10867	Engineering Mechanics Lab/Engg. Chemistry Lab	0	0	2			25	50	75	1
11	10875/GP-201	General Proficiency**	-	-	-	-	-	50	-	50	0
		Total	14/15	2/1	8	-	-	-	-	975/1025	18/20

***NOTE: Elementary Mathematics-II is for the students who passed 10+2 examination with Biology and Remedial Biology-II is for the students who passed 10+2 with Mathematics (Only for the students of Biotechnology stream). Engineering Mathematics-I is for the students of Food Technology Stream.**

****No Credit**

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

DEPARTMENT
OF
MECHANICAL ENGINEERING

SYLLABUS
2017-2018

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2017-18
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-III

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2431]	MATHEMATICS-III	3	0	0	30	20	50	100	150	3
2	[2432]	MATERIAL SCIENCE	3	0	0	30	20	50	100	150	3
3	[2433]	APPLIED THERMODYNAMICS	3	0	0	30	20	50	100	150	3
4	[2434]	STRENGTH OF MATERIAL	3	1	0	30	20	50	100	150	4
5	[2435]	FLUID MECHANICS	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[20436]	MATERIAL SCIENCE TESTING LAB	0	0	2	-	-	20	30	50	2
7	[20437]	APPLIED THERMODYHAMICS LAB	0	0	2	-	-	20	30	50	2
8	[20438]	FLUID MECHANICS LAB	0	0	2	-	-	20	30	50	2
9	[20439]	MACHINE DRAWING-I LAB	0	0	2	-	-	20	30	50	2
10	[20440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	1
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**25**

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2017-18
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-IV

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2436]	INDUSTRIAL ENGINEERING	3	0	0	30	20	50	100	150	3
2	[2437]	KINEMATIES OF MACHINE	3	0	0	30	20	50	100	150	3
3	[2438]	MANUFACTURING SCIENCE – I	3	0	0	30	20	50	100	150	3
4	[2439]	MEASUREMENT METROLOGY AND CONTROL	3	0	0	30	20	50	100	150	3
5	[2440]	ELECTRICAL MACHINIES	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[20441]	MANUFACTURING SCIENCE - I LAB	0	0	2	-	-	20	30	50	2
8	[20442]	MEASUREMENT METROLOGY AND CONTROL LAB	0	0	2	-	-	20	30	50	2
9	[20443]	MACHINE DRAWING - II LAB	0	0	2	-	-	20	30	50	2
10	[20444]	ELECTRICAL MACHINE LAB	0	0	2	-	-	20	30	50	2
11	[20445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	1
		Grand Total	**15**	0	8	**-**	**-**	**-**	**-**	**1000**	**24**

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2017-18
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-V

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3431]	INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT	3	1	0	30	20	50	100	150	3
2	[3432]	MACHINE DESIGN-I	3	0	0	30	20	50	100	150	3
3	[3433]	DYNAMICS OF MACHINE	3	0	0	30	20	50	100	150	3
4	[3434]	MANUFACTURING SCIENCE – II	3	0	0	30	20	50	100	150	3
5	[3435]	HEAT AND MASS TRANSFER	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[30436]	MACHINE DESIGN - I LAB	0	0	2	-	-	20	30	50	2
8	[30437]	DYNAMICS OF MACHINE LAB	0	0	2	-	-	20	30	50	2
9	[30438]	MANUFACTURING SCIENCE - II LAB	0	0	2	-	-	20	30	50	2
10	[30439]	HEAT AND MASS TRANSFER LAB	0	0	2	-	-	20	30	50	2
11	[30440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	1
		Grand Total	**15**	1	**8**	**-**	**-**	**-**	**-**	**1000**	**24**

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2017-18
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-VI

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3436]	OPERATIONS RESEARCH	3	1	0	30	20	50	100	150	3
2	[3437]	I.C. ENGINE	3	0	0	30	20	50	100	150	3
3	[3438]	MACHINE DESIGN-II	3	0	0	30	20	50	100	150	3
4	[3439]	FLUID MACHINERY	3	0	0	30	20	50	100	150	3
5	[3440]	REFRIGERATION AND AIR CONDITIONING	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[30441]	MACHINE DESIGN-II LAB	0	0	2	-	-	20	30	50	2
7	[30442]	FLUID MACHINERY LAB	0	0	2	-	-	20	30	50	2
8	[30443]	REFRIGERATION AND AIR CONDITIONING LAB	0	0	2	-	-	20	30	50	2
9	[30444]	SEMINAR	0	0	2	-	-	20	30	50	2
10	[30445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	1
		Grand Total	**15**	1	**8**	**-**	**-**	**-**	**-**	**1000**	**24**

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
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B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4431]	COMPUTER AIDED DESIGN	3	1	0	30	20	50	100	150	3
2	[4432]	COMPUTER AIDED MANUFACTURING	3	0	0	30	20	50	100	150	3
3	[4433]	AUTOMOBILE ENGINEERING	3	0	0	30	20	50	100	150	3
4		ELECTIVE-I	3	0	0	30	20	50	100	150	3
5		ELECTIVE-II	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40449]	CAD/CAM LAB	0	0	2	-	-	20	30	50	2
7	[40450]	AUTOMOBILE ENGG.LAB	0	0	2	-	-	20	30	50	2
8	[40451]	INDUSTRIAL TRAINING	0	0	2	-	-	20	30	50	2
9	[40452]	MINI PROJECT REPORT	0	0	2	-	-	20	30	50	2
10	[40453]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	1
		Grand Total	**15**	1	**8**	**-**	**-**	**-**	**-**	**1000**	**24**

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2017-18
B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VIII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4451]	POWER PLANT ENGINEERING	3	1	0	30	20	50	100	150	3
2	[4452]	MECHANICAL SYSTEM DESIGN	3	0	0	30	20	50	100	150	3
3	[4453]	PROJECT MANAGEMENT	3	0	0	30	20	50	100	150	3
4		ELECTIVE -III	3	0	0	30	20	50	100	150	3
5		ELECTIVE -IV	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40473]	MAJOR PROJECT	0	0	8	-	-	50	150	200	9
7	[40447]	GENERAL PROFECIENCY	0	0	0	-	-	50	-	50	1
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**25**

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2017-18
B.Tech. (Mechanical Engineering)

DETAILS OF DEPARTMENTAL ELECTIVES

ELECTIVE-1

1. UNCONVENTIONAL MANUFACTURING PROCESSES
2. **PRODUCT DEVELOPMENT AND DESIGN**
3. RELIABILITY ENGINEERING
4. MECHANICAL VIBRATION

ELECTIVE-II

1. OPTIMISATION TECHNIQUES IN ENGINEERING
2. **TOTAL QUALITY MANAGEMENT (TQM)**
3. PRODUCTION & OPERATIONS MANAGEMENT
4. MAINTENANCE ENGINEERING & MANAGEMENT

ELECTIVE-III

1. **NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION**
2. MANAGEMENT INFORMATION SYSTEM
3. TRIBOLOGY
4. FINITE ELEMENT METHOD

ELECTIVE-IV

1. **ADVANCED WELDING TECHNOLOGY**
2. NON-DESTRUCTIVE TESTING
3. ADVANCED MATERIALS TECHNOLOGY
4. ENERGY MANAGEMENT

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

DEPARTMENT
OF
MECHANICAL ENGINEERING

SYLLABUS
2018-2019

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-III

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2431]	MATHEMATICS-III	3	0	0	30	20	50	100	150	3
2	[2432]	MATERIAL SCIENCE	3	0	0	30	20	50	100	150	3
3	[2433]	APPLIED THERMODYNAMICS	3	0	0	30	20	50	100	150	3
4	[2434]	STRENGTH OF MATERIAL	3	1	0	30	20	50	100	150	4
5	[2435]	FLUID MECHANICS	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[20436]	MATERIAL SCIENCE TESTING LAB	0	0	2	-	-	20	30	50	2
7	[20437]	APPLIED THERMODYHAMICS LAB	0	0	2	-	-	20	30	50	2
8	[20438]	FLUID MECHANICS LAB	0	0	2	-	-	20	30	50	2
9	[20439]	MACHINE DRAWING-I LAB	0	0	2	-	-	20	30	50	2
10	[20440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Total	**15**	1	**8**					**950**	**24**

Note: Marks for [20440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-IV

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2436]	INDUSTRIAL ENGINEERING	3	0	0	30	20	50	100	150	3
2	[2437]	KINEMATIES OF MACHINE	3	1	0	30	20	50	100	150	4
3	[2438]	MANUFACTURING SCIENCE – I	3	0	0	30	20	50	100	150	3
4	[2439]	MEASUREMENT METROLOGY AND CONTROL	3	0	0	30	20	50	100	150	3
5	[2440]	ELECTRICAL MACHINIES	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[20441]	MANUFACTURING SCIENCE - I LAB	0	0	2	-	-	20	30	50	2
8	[20442]	MEASUREMENT METROLOGY AND CONTROL LAB	0	0	2	-	-	20	30	50	2
9	[20443]	MACHINE DRAWING - II LAB	0	0	2	-	-	20	30	50	2
10	[20444]	ELECTRICAL MACHINE LAB	0	0	2	-	-	20	30	50	2
11	[20445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Total	**15**	**1**	**8**					**950**	**24**

Note: Marks for [20445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-V

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3431]	INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT	2	0	0	30	20	50	100	150	2
2	[3432]	MACHINE DESIGN-I	3	0	0	30	20	50	100	150	3
3	[3433]	DYNAMICS OF MACHINE	3	0	0	30	20	50	100	150	3
4	[3434]	MANUFACTURING SCIENCE – II	3	0	0	30	20	50	100	150	3
5	[3435]	HEAT AND MASS TRANSFER	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[30436]	MACHINE DESIGN - I LAB	0	0	2	-	-	20	30	50	1
8	[30437]	DYNAMICS OF MACHINE LAB	0	0	2	-	-	20	30	50	1
9	[30438]	MANUFACTURING SCIENCE - II LAB	0	0	2	-	-	20	30	50	1
10	[30439]	HEAT AND MASS TRANSFER LAB	0	0	2	-	-	20	30	50	1
11	[30440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Total	**14**	0	**8**	**-**	**-**	**-**	**-**	**950**	**18**

Note: Marks for [30440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-VI

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3436]	OPERATIONS RESEARCH	2	0	0	30	20	50	100	150	2
2	[3437]	I.C. ENGINE	3	0	0	30	20	50	100	150	3
3	[3438]	MACHINE DESIGN-II	3	0	0	30	20	50	100	150	3
4	[3439]	FLUID MACHINERY	3	0	0	30	20	50	100	150	3
5	[3440]	REFRIGERATION AND AIR CONDITIONING	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[30441]	MACHINE DESIGN-II LAB	0	0	2	-	-	20	30	50	1
7	[30442]	FLUID MACHINERY LAB	0	0	2	-	-	20	30	50	1
8	[30443]	REFRIGERATION AND AIR CONDITIONING LAB	0	0	2	-	-	20	30	50	1
9	[30444]	SEMINAR	0	0	2	-	-	20	30	50	1
10	[30445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Total	**14**	0	**8**					**950**	**18**

Note: Marks for [30445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4431]	COMPUTER AIDED DESIGN	3	0	0	30	20	50	100	150	3
2	[4432]	COMPUTER AIDED MANUFACTURING	3	0	0	30	20	50	100	150	3
3	[4433]	AUTOMOBILE ENGINEERING	3	0	0	30	20	50	100	150	3
4		ELECTIVE -I	2	0	0	30	20	50	100	150	2
5		ELECTIVE -II	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40449]	CAD/CAM LAB	0	0	2	-	-	20	30	50	1
7	[40450]	AUTOMOBILE ENGG.LAB	0	0	2	-	-	20	30	50	1
8	[40451]	INDUSTRIAL TRAINING	0	0	2	-	-	20	30	50	1
9	[40452]	MINI PROJECT REPORT	0	0	2	-	-	20	30	50	1
10	[40453]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Total	**14**	0	**8**	**-**	**-**	**-**	**-**	**950**	**18**

Note: Marks for [40453] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
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YEAR IV, SEMESTER-VIII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4451]	POWER PLANT ENGINEERING	3	0	0	30	20	50	100	150	3
2	[4452]	MECHANICAL SYSTEM DESIGN	3	0	0	30	20	50	100	150	3
3	[4453]	PROJECT MANAGEMENT	2	0	0	30	20	50	100	150	2
4		ELECTIVE -III	3	0	0	30	20	50	100	150	3
5		ELECTIVE -IV	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40473]	MAJOR PROJECT	0	0	8	-	-	50	150	200	6
7	[40447]	GENERAL PROFECIENCY	0	0	0	-	-	50	-	50	0
		Total	**14**	**0**	**8**	**-**	**-**	**-**	**-**	**950**	**20**

Note: Marks for [40447] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2018 -19
B.Tech. (Mechanical Engineering)

DETAILS OF DEPARTMENTAL ELECTIVES

ELECTIVE-1

1. UNCONVENTIONAL MANUFACTURING PROCESSES
2. **PRODUCT DEVELOPMENT AND DESIGN**
3. RELIABILITY ENGINEERING
4. MECHANICAL VIBRATION

ELECTIVE-II

1. OPTIMISATION TECHNIQUES IN ENGINEERING
2. **TOTAL QUALITY MANAGEMENT (TQM)**
3. PRODUCTION & OPERATIONS MANAGEMENT
4. MAINTENANCE ENGINEERING & MANAGEMENT

ELECTIVE-III

1. **NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION**
2. MANAGEMENT INFORMATION SYSTEM
3. TRIBOLOGY
4. FINITE ELEMENT METHOD

ELECTIVE-IV

1. **ADVANCED WELDING TECHNOLOGY**
2. NON-DESTRUCTIVE TESTING
3. ADVANCED MATERIALS TECHNOLOGY
4. ENERGY MANAGEMENT

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

DEPARTMENT
OF
MECHANICAL ENGINEERING

SYLLABUS
2019-2020

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-III

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2431]	MATHEMATICS-III	3	0	0	30	20	50	100	150	3
2	[2432]	MATERIAL SCIENCE	3	0	0	30	20	50	100	150	3
3	[2433]	APPLIED THERMODYNAMICS	3	0	0	30	20	50	100	150	3
4	[2434]	STRENGTH OF MATERIAL	3	1	0	30	20	50	100	150	4
5	[2435]	FLUID MECHANICS	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[20436]	MATERIAL SCIENCE TESTING LAB	0	0	2	-	-	20	30	50	1
7	[20437]	APPLIED THERMODYHAMICS LAB	0	0	2	-	-	20	30	50	1
8	[20438]	FLUID MECHANICS LAB	0	0	2	-	-	25	50	75	1
9	[20439]	MACHINE DRAWING-I LAB	0	0	2	-	-	25	50	75	1
10	[20440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**					**1000**	**20**

Note: Marks for [20440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-IV

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2436]	INDUSTRIAL ENGINEERING	3	0	0	30	20	50	100	150	3
2	[2437]	KINEMATIES OF MACHINE	3	1	0	30	20	50	100	150	4
3	[2438]	MANUFACTURING SCIENCE – I	3	0	0	30	20	50	100	150	3
4	[2439]	MEASUREMENT METROLOGY AND CONTROL	3	0	0	30	20	50	100	150	3
5	[2440]	ELECTRICAL MACHINIES	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[20441]	MANUFACTURING SCIENCE - I LAB	0	0	2	-	-	25	50	75	1
8	[20442]	MEASUREMENT METROLOGY AND CONTROL LAB	0	0	2	-	-	20	30	50	1
9	[20443]	MACHINE DRAWING - II LAB	0	0	2	-	-	25	50	75	1
10	[20444]	ELECTRICAL MACHINE LAB	0	0	2	-	-	20	30	50	1
11	[20445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**					**1000**	**20**

Note: Marks for [20445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-V

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3431]	INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT	3	0	0	30	20	50	100	150	3
2	[3432]	MACHINE DESIGN-I	3	0	0	30	20	50	100	150	3
3	[3433]	DYNAMICS OF MACHINE	3	0	0	30	20	50	100	150	3
4	[3434]	MANUFACTURING SCIENCE – II	3	0	0	30	20	50	100	150	3
5	[3435]	HEAT AND MASS TRANSFER	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
7	[30436]	MACHINE DESIGN - I LAB	0	0	2	-	-	25	50	75	1
8	[30437]	DYNAMICS OF MACHINE LAB	0	0	2	-	-	25	50	75	1
9	[30438]	MANUFACTURING SCIENCE - II LAB	0	0	2	-	-	20	30	50	1
10	[30439]	HEAT AND MASS TRANSFER LAB	0	0	2	-	-	20	30	50	1
11	[30440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**20**

Note: Marks for [30440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-VI

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3436]	OPERATIONS RESEARCH	3	1	0	30	20	50	100	150	4
2	[3437]	I.C. ENGINE	3	0	0	30	20	50	100	150	3
3	[3438]	MACHINE DESIGN-II	3	0	0	30	20	50	100	150	3
4	[3439]	FLUID MACHINERY	3	0	0	30	20	50	100	150	3
5	[3440]	REFRIGERATION AND AIR CONDITIONING	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[30441]	MACHINE DESIGN-II LAB	0	0	2	-	-	20	30	50	1
7	[30442]	FLUID MACHINERY LAB	0	0	2	-	-	20	30	50	1
8	[30443]	REFRIGERATION AND AIR CONDITIONING LAB	0	0	2	-	-	20	30	50	1
9	[30444]	SEMINAR	0	0	2	-	-	-	-	100	1
10	[30445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**					**1000**	**20**

Note: Marks for [30445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4431]	COMPUTER AIDED DESIGN	3	1	0	30	20	50	100	150	4
2	[4432]	COMPUTER AIDED MANUFACTURING	3	0	0	30	20	50	100	150	3
3	[4433]	AUTOMOBILE ENGINEERING	3	0	0	30	20	50	100	150	3
4		ELECTIVE-I	3	0	0	30	20	50	100	150	3
5		ELECTIVE-II	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40449]	CAD/CAM LAB	0	0	2	-	-	20	30	50	1
7	[40450]	AUTOMOBILE ENGG.LAB	0	0	2	-	-	20	30	50	1
8	[40451]	INDUSTRIAL TRAINING	0	0	2	-	-	-	-	75	1
9	[40452]	MINI PROJECT REPORT	0	0	2	-	-	-	-	75	1
10	[40453]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**	**-**	**-**	**-**	**-**	**1000**	**20**

Note: Marks for [40453] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VIII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4451]	POWER PLANT ENGINEERING	3	1	0	30	20	50	100	150	4
2	[4452]	MECHANICAL SYSTEM DESIGN	3	0	0	30	20	50	100	150	3
3	[4453]	PROJECT MANAGEMENT	3	0	0	30	20	50	100	150	3
4		ELECTIVE -III	3	0	0	30	20	50	100	150	3
5		ELECTIVE -IV	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40473]	MAJOR PROJECT	0	0	8	-	-	100	150	250	6
7	[40447]	GENERAL PROFECIENCY	0	0	0	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**22**

Note: Marks for [40447] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
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INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2019-20
B.Tech. (Mechanical Engineering)

DETAILS OF DEPARTMENTAL ELECTIVES

ELECTIVE-1

1. UNCONVENTIONAL MANUFACTURING PROCESSES
2. **PRODUCT DEVELOPMENT AND DESIGN**
3. RELIABILITY ENGINEERING
4. MECHANICAL VIBRATION

ELECTIVE-II

1. OPTIMISATION TECHNIQUES IN ENGINEERING
2. **TOTAL QUALITY MANAGEMENT (TQM)**
3. PRODUCTION & OPERATIONS MANAGEMENT
4. MAINTENANCE ENGINEERING & MANAGEMENT

ELECTIVE-III

1. **NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION**
2. MANAGEMENT INFORMATION SYSTEM
3. TRIBOLOGY
4. FINITE ELEMENT METHOD

ELECTIVE-IV

1. **ADVANCED WELDING TECHNOLOGY**
2. NON-DESTRUCTIVE TESTING
3. ADVANCED MATERIALS TECHNOLOGY
4. ENERGY MANAGEMENT

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

DEPARTMENT
OF
MECHANICAL ENGINEERING

SYLLABUS
2020-2021

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-III

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2431]	MATHEMATICS-III	3	0	0	30	20	50	100	150	3
2	[2432]	MATERIAL SCIENCE	3	0	0	30	20	50	100	150	3
3	[2433]	APPLIED THERMODYNAMICS	3	0	0	30	20	50	100	150	3
4	[2434]	STRENGTH OF MATERIAL	3	1	0	30	20	50	100	150	4
5	[2435]	FLUID MECHANICS	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[20436]	MATERIAL SCIENCE TESTING LAB	0	0	2	-	-	20	30	50	1
7	[20437]	APPLIED THERMODYHAMICS LAB	0	0	2	-	-	20	30	50	1
8	[20438]	FLUID MECHANICS LAB	0	0	2	-	-	25	50	75	1
9	[20439]	MACHINE DRAWING-I LAB	0	0	2	-	-	25	50	75	1
10	[20440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**					**1000**	**20**

Note: Marks for [20440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-IV

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2436]	INDUSTRIAL ENGINEERING	3	0	0	30	20	50	100	150	3
2	[2437]	KINEMATIES OF MACHINE	3	1	0	30	20	50	100	150	4
3	[2438]	MANUFACTURING SCIENCE – I	3	0	0	30	20	50	100	150	3
4	[2439]	MEASUREMENT METROLOGY AND CONTROL	3	0	0	30	20	50	100	150	3
5	[2440]	ELECTRICAL MACHINIES	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[20441]	MANUFACTURING SCIENCE - I LAB	0	0	2	-	-	25	50	75	1
8	[20442]	MEASUREMENT METROLOGY AND CONTROL LAB	0	0	2	-	-	20	30	50	1
9	[20443]	MACHINE DRAWING - II LAB	0	0	2	-	-	25	50	75	1
10	[20444]	ELECTRICAL MACHINE LAB	0	0	2	-	-	20	30	50	1
11	[20445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**					**1000**	**20**

Note: Marks for [20445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-V

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3431]	INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT	3	0	0	30	20	50	100	150	3
2	[3432]	MACHINE DESIGN-I	3	0	0	30	20	50	100	150	3
3	[3433]	DYNAMICS OF MACHINE	3	0	0	30	20	50	100	150	3
4	[3434]	MANUFACTURING SCIENCE – II	3	0	0	30	20	50	100	150	3
5	[3435]	HEAT AND MASS TRANSFER	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
7	[30436]	MACHINE DESIGN - I LAB	0	0	2	-	-	25	50	75	1
8	[30437]	DYNAMICS OF MACHINE LAB	0	0	2	-	-	25	50	75	1
9	[30438]	MANUFACTURING SCIENCE - II LAB	0	0	2	-	-	20	30	50	1
10	[30439]	HEAT AND MASS TRANSFER LAB	0	0	2	-	-	20	30	50	1
11	[30440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**20**

Note: Marks for [30440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-VI

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3436]	OPERATIONS RESEARCH	3	1	0	30	20	50	100	150	4
2	[3437]	I.C. ENGINE	3	0	0	30	20	50	100	150	3
3	[3438]	MACHINE DESIGN-II	3	0	0	30	20	50	100	150	3
4	[3439]	FLUID MACHINERY	3	0	0	30	20	50	100	150	3
5	[3440]	REFRIGERATION AND AIR CONDITIONING	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[30441]	MACHINE DESIGN-II LAB	0	0	2	-	-	20	30	50	1
7	[30442]	FLUID MACHINERY LAB	0	0	2	-	-	20	30	50	1
8	[30443]	REFRIGERATION AND AIR CONDITIONING LAB	0	0	2	-	-	20	30	50	1
9	[30444]	SEMINAR	0	0	2	-	-	-	-	100	1
10	[30445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**					**1000**	**20**

Note: Marks for [30445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

TA: Teaching Assessment
ESE: End Semester Examination

YEAR IV, SEMESTER-VII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4431]	COMPUTER AIDED DESIGN	3	1	0	30	20	50	100	150	4
2	[4432]	COMPUTER AIDED MANUFACTURING	3	0	0	30	20	50	100	150	3
3	[4433]	AUTOMOBILE ENGINEERING	3	0	0	30	20	50	100	150	3
4		ELECTIVE-I	3	0	0	30	20	50	100	150	3
5		ELECTIVE-II	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40449]	CAD/CAM LAB	0	0	2	-	-	20	30	50	1
7	[40450]	AUTOMOBILE ENGG.LAB	0	0	2	-	-	20	30	50	1
8	[40451]	INDUSTRIAL TRAINING	0	0	2	-	-	-	-	75	1
9	[40452]	MINI PROJECT REPORT	0	0	2	-	-	-	-	75	1
10	[40453]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**	**-**	**-**	**-**	**-**	**1000**	**20**

Note: Marks for [40453] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

ESE: End Semester Examination

YEAR IV, SEMESTER-VIII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4451]	POWER PLANT ENGINEERING	3	1	0	30	20	50	100	150	4
2	[4452]	MECHANICAL SYSTEM DESIGN	3	0	0	30	20	50	100	150	3
3	[4453]	PROJECT MANAGEMENT	3	0	0	30	20	50	100	150	3
4		ELECTIVE -III	3	0	0	30	20	50	100	150	3
5		ELECTIVE -IV	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40473]	MAJOR PROJECT	0	0	8	-	-	100	150	250	6
7	[40447]	GENERAL PROFECIENCY	0	0	0	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**22**

Note: Marks for [40447] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Prof. S. K. Katiyar	Er. Brajendra Shukla	Er. Vishal Arya	Er. Jitendra Verma	Er. Rahul Shukla
Dean /Director Engineering	Academic Coordinator	Coordinator/Convener	Internal Member	Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2020-21
B.Tech. (Mechanical Engineering)

DETAILS OF DEPARTMENTAL ELECTIVES

ELECTIVE-1

1. UNCONVENTIONAL MANUFACTURING PROCESSES
2. **PRODUCT DEVELOPMENT AND DESIGN**
3. RELIABILITY ENGINEERING
4. MECHANICAL VIBRATION

ELECTIVE-II

1. OPTIMISATION TECHNIQUES IN ENGINEERING
2. **TOTAL QUALITY MANAGEMENT (TQM)**
3. PRODUCTION & OPERATIONS MANAGEMENT
4. MAINTENANCE ENGINEERING & MANAGEMENT

ELECTIVE-III

1. **NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION**
2. MANAGEMENT INFORMATION SYSTEM
3. TRIBOLOGY
4. FINITE ELEMENT METHOD

ELECTIVE-IV

1. **ADVANCED WELDING TECHNOLOGY**
2. NON-DESTRUCTIVE TESTING
3. ADVANCED MATERIALS TECHNOLOGY
4. ENERGY MANAGEMENT

Prof. S. K. Katiyar Dean /Director Engineering	Er. Brajendra Shukla Academic Coordinator	Er. Vishal Arya Coordinator/Convener	Er. Jitendra Verma Internal Member	Er. Rahul Shukla Internal Member

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

DEPARTMENT
OF
MECHANICAL ENGINEERING

SYLLABUS
2021-2022

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2021-22
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-III

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2431]	MATHEMATICS-III	3	0	0	30	20	50	100	150	3
2	[2432]	MATERIAL SCIENCE	3	0	0	30	20	50	100	150	3
3	[2433]	APPLIED THERMODYNAMICS	3	0	0	30	20	50	100	150	3
4	[2434]	STRENGTH OF MATERIAL	3	1	0	30	20	50	100	150	4
5	[2435]	FLUID MECHANICS	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[20436]	MATERIAL SCIENCE TESTING LAB	0	0	2	-	-	20	30	50	1
7	[20437]	APPLIED THERMODYHAMICS LAB	0	0	2	-	-	20	30	50	1
8	[20438]	FLUID MECHANICS LAB	0	0	2	-	-	25	50	75	1
9	[20439]	MACHINE DRAWING-I LAB	0	0	2	-	-	25	50	75	1
10	[20440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**					**1000**	**20**

Note: Marks for [20440] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Er. Sandip Mishra	Er. Shashikant Verma	Er. Vishal Arya	Er. Brajendra Shukla	Prof. S. K. Katiyar
Internal Member	Internal Member	Coordinator/Convener	Academic Coordinator	Dean Engineering

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STUDY AND EVALUATION SCHEME
W.e.f. 2021-22
B.Tech. (Mechanical Engineering)

YEAR II, SEMESTER-IV

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[2436]	INDUSTRIAL ENGINEERING	3	0	0	30	20	50	100	150	3
2	[2437]	KINEMATIES OF MACHINE	3	1	0	30	20	50	100	150	4
3	[2438]	MANUFACTURING SCIENCE – I	3	0	0	30	20	50	100	150	3
4	[2439]	MEASUREMENT METROLOGY AND CONTROL	3	0	0	30	20	50	100	150	3
5	[2440]	ELECTRICAL MACHINIES	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7	[20441]	MANUFACTURING SCIENCE - I LAB	0	0	2	-	-	25	50	75	1
8	[20442]	MEASUREMENT METROLOGY AND CONTROL LAB	0	0	2	-	-	20	30	50	1
9	[20443]	MACHINE DRAWING - II LAB	0	0	2	-	-	25	50	75	1
10	[20444]	ELECTRICAL MACHINE LAB	0	0	2	-	-	20	30	50	1
11	[20445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**					**1000**	**20**

Note: Marks for [20445] GENERAL PROFECIENCY are not included in the Grand total

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TA: Teaching Assessment
ESE: End Semester Examination

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STUDY AND EVALUATION SCHEME
W.e.f. 2021-22
B.Tech. (Mechanical Engineering)

YEAR III, SEMESTER-V

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3431]	INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT	3	0	0	30	20	50	100	150	3
2	[3432]	MACHINE DESIGN-I	3	0	0	30	20	50	100	150	3
3	[3433]	DYNAMICS OF MACHINE	3	0	0	30	20	50	100	150	3
4	[3434]	MANUFACTURING SCIENCE – II	3	0	0	30	20	50	100	150	3
5	[3435]	HEAT AND MASS TRANSFER	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
7	[30436]	MACHINE DESIGN - I LAB	0	0	2	-	-	25	50	75	1
8	[30437]	DYNAMICS OF MACHINE LAB	0	0	2	-	-	25	50	75	1
9	[30438]	MANUFACTURING SCIENCE - II LAB	0	0	2	-	-	20	30	50	1
10	[30439]	HEAT AND MASS TRANSFER LAB	0	0	2	-	-	20	30	50	1
11	[30440]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**20**

Note: Marks for [30440] GENERAL PROFECIENCY are not included in the Grand total

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ESE: End Semester Examination

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YEAR III, SEMESTER-VI

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[3436]	OPERATIONS RESEARCH	3	1	0	30	20	50	100	150	4
2	[3437]	I.C. ENGINE	3	0	0	30	20	50	100	150	3
3	[3438]	MACHINE DESIGN-II	3	0	0	30	20	50	100	150	3
4	[3439]	FLUID MACHINERY	3	0	0	30	20	50	100	150	3
5	[3440]	REFRIGERATION AND AIR CONDITIONING	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[30441]	MACHINE DESIGN-II LAB	0	0	2	-	-	20	30	50	1
7	[30442]	FLUID MACHINERY LAB	0	0	2	-	-	20	30	50	1
8	[30443]	REFRIGERATION AND AIR CONDITIONING LAB	0	0	2	-	-	20	30	50	1
9	[30444]	SEMINAR	0	0	2	-	-	-	-	100	1
10	[30445]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**					**1000**	**20**

Note: Marks for [30445] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
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ESE: End Semester Examination

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BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2021-22
B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4431]	COMPUTER AIDED DESIGN	3	1	0	30	20	50	100	150	4
2	[4432]	COMPUTER AIDED MANUFACTURING	3	0	0	30	20	50	100	150	3
3	[4433]	AUTOMOBILE ENGINEERING	3	0	0	30	20	50	100	150	3
4		ELECTIVE-I	3	0	0	30	20	50	100	150	3
5		ELECTIVE-II	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40449]	CAD/CAM LAB	0	0	2	-	-	20	30	50	1
7	[40450]	AUTOMOBILE ENGG.LAB	0	0	2	-	-	20	30	50	1
8	[40451]	INDUSTRIAL TRAINING	0	0	2	-	-	-	-	75	1
9	[40452]	MINI PROJECT REPORT	0	0	2	-	-	-	-	75	1
10	[40453]	GENERAL PROFECIENCY	-	-	-	-	-	50	-	50	0
		Grand Total	**15**	1	**8**	**-**	**-**	**-**	**-**	**1000**	**20**

Note: Marks for [40453] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Er. Sandip Mishra	Er. Shashikant Verma	Er. Vishal Arya	Er. Brajendra Shukla	Prof. S. K. Katiyar
Internal Member	Internal Member	Coordinator/Convener	Academic Coordinator	Dean Engineering

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
STUDY AND EVALUATION SCHEME
W.e.f. 2021-22
B.Tech. (Mechanical Engineering)

YEAR IV, SEMESTER-VIII

SN	COURSE CODE	SUBJECT	PERIODS			EVOLUTION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	[4451]	POWER PLANT ENGINEERING	3	1	0	30	20	50	100	150	4
2	[4452]	MECHANICAL SYSTEM DESIGN	3	0	0	30	20	50	100	150	3
3	[4453]	PROJECT MANAGEMENT	3	0	0	30	20	50	100	150	3
4		ELECTIVE -III	3	0	0	30	20	50	100	150	3
5		ELECTIVE -IV	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6	[40473]	MAJOR PROJECT	0	0	8	-	-	100	150	250	6
7	[40447]	GENERAL PROFECIENCY	0	0	0	-	-	50	-	50	0
		Grand Total	**15**	**1**	**8**	**-**	**-**	**-**	**-**	**1000**	**22**

Note: Marks for [40447] GENERAL PROFECIENCY are not included in the Grand total

CT: Class Test
TA: Teaching Assessment
ESE: End Semester Examination

Er. Sandip Mishra	Er. Shashikant Verma	Er. Vishal Arya	Er. Brajendra Shukla	Prof. S. K. Katiyar
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INSTITUTE OF ENGINEERING & TECHNOLOGY
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STUDY AND EVALUATION SCHEME
W.e.f. 2021-22
B.Tech. (Mechanical Engineering)

DETAILS OF DEPARTMENTAL ELECTIVES

ELECTIVE-1

1. UNCONVENTIONAL MANUFACTURING PROCESSES
2. **PRODUCT DEVELOPMENT AND DESIGN (4435)**
3. RELIABILITY ENGINEERING
4. MECHANICAL VIBRATION

ELECTIVE-II

1. OPTIMISATION TECHNIQUES IN ENGINEERING
2. **TOTAL QUALITY MANAGEMENT (4439)**
3. PRODUCTION & OPERATIONS MANAGEMENT
4. MAINTENANCE ENGINEERING & MANAGEMENT

ELECTIVE-III

1. **NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION (4454)**
2. MANAGEMENT INFORMATION SYSTEM
3. TRIBOLOGY
4. FINITE ELEMENT METHOD

ELECTIVE-IV

1. **ADVANCED WELDING TECHNOLOGY (4458)**
2. NON-DESTRUCTIVE TESTING
3. ADVANCED MATERIALS TECHNOLOGY
4. ENERGY MANAGEMENT

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BUNDELKHAND UNIVERSITY

JHANSI

Institute of Engineering Technology

Syllabus for

B.Tech (Mechanical Engineering)

Choice based credit System

Department of Mechanical Engineering

Course Structure and Scheme of Examination

B.Tech. (Mechanical Engineering)

VISION:

The Department of Mechanical aims to be recognized as a leader in mechanical engineering education and research. This vision will be fulfilled through excellence in education and targeted research themes in emerging areas.

MISSION:

The mission of the Mechanical Engineering Department is to educate and prepare students at graduate levels for leadership roles in the fields of Mechanical Engineering to conduct research for the benefit of society.

Department Objective

1. Aiming to produce successful graduates having technical knowledge along with ethical behavior for sustainable development of society.

2. Explain on technological innovation, critical thinking, and problem solving skills through rigorous course work of mechanical engineering.

3. Exposed to ever increasing challenges in technological advancement and trained through various pedagogical skills.4. Providing necessary technical and design making abilities to compete globally and to full fill society needs.

Program Outcomes (PO)

PO-1: Engineer graduates will be able to engage in independent and lifelong learning in the context of technological change.

PO-2: Engineer aspirants will be able to identify design solutions to complex engineering problems considering public health and environmental factors.

PO-3: Graduate will able to lead in diverse team or function efficiently as an individual member in order to understand and successfully manage group and teamwork.

PO-4: Engineering graduates will be able to use of fundamentals of engineering and science to the solution of various engineering problems through research-based knowledge, experimental analysis, and interpretation of data to provide valid solutions.

PO-5: Graduate will be able to comprehend, and communicate complex engineering activities and recent advancements.

B.Tech. (Mechanical Engineering)

Program Specific Outcomes (PSO)

PSO 1: Learning to apply knowledge of fundamentals of science, mathematics engineering basics of all fields to the conceptualization of engineering models.

PSO 2: To Identify, formulate, research literature, and solve complex engineering problems reaching substantiated conclusions using the first principles of mathematics and engineering sciences.

PSO 3: To find out Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PSO 4: Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PSO 5: Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PSO 6: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PSO 7: Convey effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PSO 8: To manifest understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.

PSO 9: Understand and commit to professional ethics and responsibilities and norms of engineering practice.

PSO 10: To Understand and acknowledge the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.

PSO 11: Demonstrate knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations.

PSO 12: Identify the need for, and have the ability to engage in independent and life-long learning.

[2431] Engineering Mathematics - III L T P: 3 1 0

Course Objectives:

1. To solve and evaluate the problem of complex Number.
2. Applications of probability on daily life problems.

Course Outcomes:

1. Students get good knowledge about complex problems and their implementation.
2. Application of probability in complex problem.

SYLLABUS

Unit – I: Function of Complex variable
Analytic function, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals of the type. **10**

Unit – II: Statistical Techniques - I
Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, etc., Correlation, Linear, non –linear and multiple regression analysis, Probability theory. **8**

Unit – III: Statistical Techniques - II
Binomial, Poisson, and Normal distributions, Sampling theory (small and large), Tests of significations: Chi-square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc. Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, R, p, np, and c charts. **8**

Unit – IV: Numerical Techniques – I
Zeroes of transcendental and polynomial equation using Bisection method, Regulafalsi method and Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals. **8**

Unit – V: Numerical Techniques –II
Solution of system of linear equations, Gauss- Seidal method, Crout method. Numerical differentiation, Numerical integration, Trapezoidal, Simpson's one third and three-eight rules, Solution of ordinary differential (first order, second order and simultaneous) equations by Euler's, Picard's and forth-order Runge- Kutta methods. **8**

Test Books: -

1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi, 2003.
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd., 2000.

Reference Books: -

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House,2002.
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.

5. Devi Prasad, An introduction to Numerical Analysis, Narosa Publication house, New Delhi2006.
6. T. Veerajan & T. Ramchandrandran, Theory & Problems in Numerical Methods, TMH, New Delhi, 2004.
7. S.P.Gupta, Statistical Methods, Sultan and Sons, New Delhi, 2004.
8. Devore, Probability and Statistics, Thomson (Cengage) Learning, 2007.
9. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, 2003.

[2433] **Applied Thermodynamics** **L T P: 3 0 0**

Course Objectives:

1. To learn about work and heat interactions and relationships, and the balance of energy between System and its surroundings.
2. To learn about the application of I law and II law to various energy conversion devices.
3. To study and evaluate the changes in properties of substances in various thermodynamic processes.
4. To understand the difference between high-grade and low-grade energies and II law limitations on energy conversion
5. To learn about various mathematical relations of heat and properties
6. To learn about vapor and gaseous cycles with their first law and second law considerations.
7. To understand about the properties of dry and wet steam produced by boilers.
8. To learn about the gas dynamics behavior of air and steam when flowing through nozzles.
9. To analyze and evaluate the performance of steam and gas turbines.

Course Outcomes:

1. For understanding and develop the capability of applying and analyzing the fundamental concepts of basic thermodynamics
2. To evaluate and solve the applied problems of first and second law of thermodynamics.
3. To evaluate and analyse, how to use the concept of entropy, availability and irreversibility.
4. To evaluate and analyse how to apply the steam table for finding the different properties of steam and to explain the basic concept of IC engines.
5. To apply knowledge for deriving and explaining the application of Different Thermodynamic relations.
6. To identify and evaluate the combustion of fuels generation of steam and working of Steam Generators as well performance of boilers.
7. To communicate effectively to analyse and evaluate the performance of the Rankine Cycle, Steam Engine, and Nozzles.
8. To evaluate and analyse the working of Steam Turbines and Vapour power cycles and solve the numerical with concern.
9. To apply the analysis to explain the working of Gas turbines and Jet propulsion engines and evaluate the performance of Gas turbines and jet engines.

SYLLABUS

Unit- I

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature, and its' measurement, Temperature scales. **1**

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, first law of thermodynamics, Internal energy and enthalpy, first law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for a closed system (Non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law

of thermodynamics, PMM-I. **4**

Second law: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and its corollaries, thermodynamic temperature scale, PMM-II. **4**

Entropy: Clausius inequality, Concept of Entropy, Entropy changes in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics. **4**

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function. **3**

Unit – II

Properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, the Phase transformation process of water, Graphical representation of pressure, volume, and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle. **5**

Introduction to working of IC engines: Compression Ignition engines, Spark Ignition engines, 2-stroke, and 4-stroke engines, Performance parameters of IC engine, Heat balance sheet. **2**

Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic & Isothermal compressibility. **3**

Fuels and Combustion: Combustion analysis, Heating Values, Air requirement, Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature. **4**

Unit-III

Boilers: Steam generators-classifications. Working on fire-tube and water-tube boilers, boiler mountings & accessories, Draught & its calculations, air preheater, feed water heater, and superheater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. **6**

Condenser: Classification of condenser, Air leakage, and Condenser performance parameters. **2**

Unit-IV

Steam Engines: Rankine and modified Rankine cycles, Working of stream engine, Classification of steam engines, Indicator diagram, Saturation curve, Missing quantity, Heat balance. **3**

Steam& Gas Nozzles: Flow through nozzle, Variation of velocity, Area and specific volume, choked flow, Throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Supersaturated flow. **4**

Unit-V

Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on

Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. **3**

Steam Turbines: Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, Impulse reaction Turbines, state point locus, Comparison with steam engines, Losses in steam turbines, Governing of turbines. **4**

Unit-VI

Gas Turbine: Gas turbine classification Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. **4**

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet, and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine. **3**

Books:

1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of Thermodynamics by Sonntag, Wiley India Pvt. Ltd.
3. Fundamentals of Classical Thermodynamics by Van Wylen, John wiley & sons.
4. Thermodynamics by J.P. Holman, McGraw Hill.
5. Engineering Thermodynamics by P.K.Nag, Tata Mc Graw Hill Pub.
6. Engineering Thermodynamics by Onkar Singh, New Age International Pub.
7. Thermal Engineering By R.K. Rajput, Laxmi Publication.
8. Engineering Thermodynamics by C.P. Arora.
9. Applied thermodynamics by Onkar Singh, New Age International (P) Publishers Ltd.
10. Basic and Applied Thermodynamics by P.K. Nag, Tata Mc Graw Hill Pub.
11. Thermal Engg. By P.L. Ballaney, Khanna Publisher
12. Theory of Stream Turbine by W.J. Kearton
13. Steam & Gas Turbine by R.Yadav, CPH Allahabad
14. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
15. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man

[2432] **MATERIAL SCIENCE** **L T P: 3 0 0**

Course Objectives:

1. To recall the basic importance of materials.
2. To make students understand the concept of appropriate materials is crucial when designing systems.
3. To make students understand the history of a material (its processing) influences its structure, and thus the material's properties and performance.
4. To make students' knowledge of an important part of failure analysis

Course Outcomes:

1. Recall the fundamental of engineering materials and their classification.
2. Understand the basic concept of new and advanced materials that are being developed including nanomaterials, biomaterials, and energy materials
3. Understand the basic need for different materials.
4. Different configuration of synthesis and processing involves the creation of a material.
5. Elementary knowledge of both from a scientific perspective, as well as from engineering.

SYLLABUS

Unit-I

Introduction: Historical perspective, the importance of materials. A brief review of modern & atomic concept in physics and Chemistry. Atomic models, Periodic table, Chemical bonding. **4**

Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, atomic packing factor and density. Miller indices. Xray crystallography techniques. Imperfections, Defects & Dislocations in solids. **3**

Unit-II

Mechanical properties and Testing: Stress-strain diagram, Ductile & brittle material, Stress vs strength. Toughness, Hardness, Fracture, Fatigue, and Creep. Testing such as Strength testing, Hardness testing, Impact testing, Fatigue testing Creep testing, Non-destructive testing (NDT). **4**

Microstructural Exam: Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of the microstructure of various metals & alloys such as Mild steel, CI, Brass. **2**

Phase Diagram and Equilibrium Diagram: Unary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type, and combination type. Iron-carbon equilibrium diagram. **4**

Unit-III

Ferrous materials: Brief introduction of iron and steel-making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses. **3**

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams. **2**

Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni, etc. and its applications. Various type Brass, Bronze, bearing materials, their properties and uses. Aluminium alloys such as Duralumin. Other advanced materials/alloys. **3**

Unit-IV

Magnetic properties: Concept of magnetism - Dia, Para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storage. **2**

Electric properties: Energy band concept of conductor, insulator, and semiconductor. Intrinsic & extrinsic semiconductors. P-n junction and transistors. Basic devices and applications. Diffusion of Solid. **3**

Super conductivity and its applications. Messier effect. Type I & II superconductors. High Tc superconductors. **2**

Unit-V

Ceramics: Structure type and properties and applications of ceramics. Mechanical/ Electrical behavior and processing of Ceramics. **2**

Plastics: Various types of polymers/plastics and their applications. Mechanical behavior and processing of plastics. Future of plastics. **2**

Other materials: Brief description of other materials such as optical and thermal materials concrete, Composite Materials, and its uses. Brief introduction to Smart materials & Nano-materials and their potential applications. **3**

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control. **2**

References:

1. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesley Publication.
2. K.M.Gupta, Materials Science, Umesh Publication.
3. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.
4. V. Raghvan - Material Science, Prentice Hall.
5. Narula - Material Science, TMH.
6. Srivastava, Srinivasan - Science of Materials Engineering, NewAge Publications.

[2434] **STRENGTH OF MATERIAL** **L T P: 3 1 0**

Course Objectives:

1. To explain the fundamental ideas and tenets of material strength.
2. To enable the calculation of the stresses and deformations that occur when objects are subject to external loads.
3. To impart the ability to apply material strength information to engineering applications and design issues.

Course Outcome:

1. Calculate the stresses and strains that axially loaded, circularly torsionated, and flexure-laden members will experience.
2. the major stresses, the maximum shearing stress, and the stresses acting on a structural part and an illustration of each.
3. Apply the theories of failure for static loading to determine the stresses and strains in members subjected to combined loading.
4. Calculate the allowed stresses and loads for straightforward bars, beams, and circular shafts.
5. Determine the stresses and strains related to pressure vessels with thin walls that are spherical and cylindrical.
6. Examine long, short columns that are vulnerable to axial loads.
7. Identify the axial, torsional, and flexural deflections and rotations caused by the three main types of loads.

SYLLABUS

UNIT-I

Compound stress and strains: Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. **3**

3-D Stress, Theory of failure, Castinglion's Theorem, Impact load: Three-dimensional state of stress & strain, equilibrium equations. Generalized Hook's Law. Theories of Failure. Castigliano's Theorem. Impact load & stresses. **5**

UNIT –II

Stresses in Beams: Review of pure Bending. Direct and shear stresses in beams due to transverse and axial loads, composite beams. **2**

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams. **4**

Torsion: Review of Torsion, combined bending & torsion of solid & hollow shafts. **2**

UNIT-III

Helical and Leaf Springs: deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs. **4**

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Ranking Gardon Formulae, Examples of columns in mechanical equipment and machines. **4**

UNIT-IV

Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain. **2**

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders. Stresses in rotating shaft and cylinders. Stresses due to interference fits. **6**

UNIT-V

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression. **4**

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section. **4**

Books:

1. Mechanics of Materials by Pytel
2. Strength of Materials by Ryder
3. Strength of Materials by Timoshenko and & Yσungs
4. Mechanics of Materials by Bear Jhonson.

[2435] **FLUID MECHANICS** **L T P: 3 0 0**

Course Objective

1. To learn about the application of mass and momentum conservation laws for fluid flows.
2. To understand the importance of dimensional analysis.
3. To calculate the velocity and pressure variations in various types of fluid flows.
4. To understand the importance of Bernoulli's equation.

Course Outcomes:

1. Understand the nature and importance of various fluid properties in static and in dynamic conditions.
2. Evaluate the fluid pressure and use various devices for measuring fluid pressure.
3. Apply Bernoulli's equation to various problems related to fluid flow and boundary layer theory.
4. Distinguish between laminar and turbulent flow and apply suitable equation to flow through pipes.
5. Understand various important dimensionless numbers and their use in model studies.

SYLLABUS

Unit-I Introduction:

Fluid and continuum, Physical properties of fluids, Rheology of fluids. **2**

Unit-II

Kinematics of Fluid flow: Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three-dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body. **6**

Unit-III

Fluid Statics: Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis. **6**

Unit-IV

Dynamics of Fluid Flow: Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, hot-wire anemometer and LDA, notches and weirs, momentum equation and its application to pipe bends. **8**

Unit-V

Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies. **6**

Unit-VI

Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and

networks. **8**

Unit-VII

Boundary Layer Analysis: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder, and an aero foil, Magnus effect. **6**

References:

1. S Narasimhan: First Course in Fluid Mechanics, University Press
2. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
3. M M Das: Fluid Mechanics & Turbomachines, Oxford University Press
4. S. K. Agarwal: Fluid Mechanics & Machinery, TMH
5. Garde, R.J., "Fluid Mechanics through Problems", New Age International Pvt. Ltd, New Delhi, 2nd Edition.
6. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons. Omc. 1946
7. I. H. Shames, "Mechanics of Fluids", McGraw Hill, Int. Student, Education, 1988.
8. Fluid Mechanics by Jagdish Lal
9. Vijay Gupta and S. K. Gupta, "Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.
10. Modi, P.N., and Seth, S.H., "Hydraulics and Fluid Machines", Standard Book House, 1989.

[20436] MATERIAL SCIENCE AND TESTING LAB L T P: 0 0 2

(A). Material Science Lab Experiments: (at least 5 of the following)

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain Size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Faradays law of electrolysis experiment.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro & Micro Examination.
10. Suitable experiment on Magnetic/ Electrical/Electronic materials.

(B). Material Testing Lab Experiments: (at least 5 of the following)

1. Strength testing of a given mild steel specimen on UTM with full details and s-e plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact testing on impact testing machine like Charpy, Izod or both.
4. Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index testing on spring testing machine.
6. Fatigue testing on fatigue testing machine.
7. Creep testing on creep testing machine.
8. Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion testing of a rod on torsion testing machine.
10. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

Objective:

1. To understand the microstructure of various materials
2. To provide the necessary material for goods based on microstructure
3. To understand the characteristics of materials at high temperatures
4. To reduce grain size using the capabilities of heat treatment

Course outcomes

1. Knowledge of how to connect characteristics to microstructure.
2. Recognize the relationships between various crystal formations and characteristics.
3. understanding of how to choose metals and alloys for industrial uses
4. Recognizing heat treatment techniques and how characteristics change
5. Enhancing material properties through various heat treatment techniques.

[20437] **APPLIED THERMODYNAMICS LAB** **L T P: 0 0 2**

Minimum 10 experiments out of following;

1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study and working of Two stroke petrol Engine
4. Study and working of Four stroke petrol Engine
5. Determination of Indicated H.P. of I.C. Engine by Morse Test
6. Prepare the heat balance for Diesel Engine test rig
7. Prepare the heat balance sheet for Petrol Engine test rig
8. Study and working of two stroke Diesel Engine
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine
11. Study of Pressure compounded steam turbine
12. Study of Impulse & Reaction turbine
13. Study of steam Engine model.
14. Study of Gas Turbine Model
15. Any other suitable experiment on thermodynamics

Course Objectives:

1. The students will try to learn, the concepts related to the operation of internal combustion 4 stroke petrol engine.
2. The students will try to learn, the concepts related to the operation of internal combustion 4 stroke diesel engine.
3. The students will try to learn, the concepts related to the operation of internal combustion 2 stroke petrol engine
4. The students will try to learn, the concepts related to the operation of internal combustion 2 stroke diesel engine.
5. The techniques for improving the efficiencies and performance of steam generators
6. The techniques for improving the efficiencies and performance of steam turbines and compressors
7. The techniques for improving the efficiencies and performance of gas turbines and steam nozzles

Course Outcomes

1. Compute the performance of 4 stroke petrol Engines.
2. Compute the performance of 4 stroke Diesel Engines.
3. Compute the performance of 2 stroke petrol Engines.
4. Compute the performance of 2 stroke diesel Engines.
5. Predict the characteristics of Fuels and Lubricates used in IC Engines.
6. Compute the Performance of steam generator.
7. Compute the Performance of steam turbine

[20438] **FLUID MECHANICS LAB** **L T P: 0 0 2**

1. To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also, to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter, venturi meter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
5. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
6. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
7. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Course Objective:

1. This laboratory's goal is to identify the numerous factors that affect fluid flow in pipes and open channels.
2. It has experiments for measuring the metacentric height of a floating vessel, studying the transition from laminar to turbulent flow.
3. It has experiments for calculating the coefficient of discharge for obstruction flow meters (venturi meters/orifice meters).
4. Determining the friction coefficient for pipes of various diameters, and calculating minor head losses in pipes.

Course outcomes

1. Select the proper pressure measurement instrument, under various flow conditions.
2. Identify a floating body's stability.
3. Examine for fluid discharge in open channels, via orifices, and pipes.
4. Calculate the pipe's primary and minor losses.

[20439] MACHINE DRAWING – I LAB L T P: 0 0 2

Introduction (1 drawing sheet): Graphics Language, Classification of drawings, Principles of drawing, IS codes for machine drawing, scales, types of lines, section lines, Dimensioning. **2**

Orthographic Projections (1 drawing sheet): Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views. **2**

Screwed fasteners (2 drawing sheet): Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, locking arrangement of nuts. **2**

Keys and Cotters and Pin joint (1 drawing sheet): Types of keys, Cotter joint or knuckle joint. **2**

Shaft Couplings (1 drawing sheet): Introduction, Rigid coupling or Flexible coupling. **2**

Riveted joints (1 drawing sheet): Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint **1**

Assembly Drawing (1 drawing sheet): Introduction, Engine parts-stuffing box, cross head **1**

Free hand sketching*: Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc. **1**

*Students may be asked to submit the free hand sketching assignment at the end of the semester

Books and References:

1. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy-New Age
2. Machine Drawing-PS Gill-SK Kataria & sons
3. Machine Drawing-N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
4. Engineering drawing Practice for School and Colleges, SP46-1988 (BIS)

Course Objectives

1. To study the 2D drawings of machine components.
2. To understanding the concepts of drawing and IS codes for machine drawing.

Course Outcomes

1. Prepare drawing different types of machine elements using orthographic projections.
2. Practice of part drawings for machine components like shaft, coupling, rivet joint, key cotter joint.
3. Prepare the assembly drawings using part drawings like engine part stuffing box and cross head.

[2437] **KINEMATICS OF MACHINES** **L T P: 3 1 0**

Course Objective:

1. Distinguish kinematic and kinetic motion.
2. Identify the basic relations between distance, time, velocity, and acceleration.
3. Apply vector mechanics as a tool for solving kinematic problems.
4. Determine the degrees of freedom (mobility) of a mechanism.
5. Use graphical and analytic methods to study the motion of a planar mechanism.
6. Design basic gear trains.
7. Design basic cam systems.

Course Outcomes:

1. Differentiate Between Kinetic and Kinematic Motion.
2. To Recognize and Count Various Link-Based Methods While Having. A Fundamental Grasp of Motion
3. Find A Mechanism & Degrees of Freedom (Mobility).
4. Determine the Fundamental Connections Between Space, Time, Speed, And Acceleration.
5. Utilize Vector Mechanics as A Technique to Solve Kinematic Acceleration and Velocity Problems.
6. To Create and Assess Various Cams and Followers' Performance.
7. To Comprehend and Utilize Appropriate Approaches to Illustrate Various Power Transfer Mechanisms by Gear and Gear Train.

SYLLABUS

UNIT I

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain **6**

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location o f instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism. **3**

UNIT II

Acceleration in Mechanisms: Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, **4**

Klein's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism **2**

Mechanisms with Lower Pairs: Pantograph, Exact straight-line motion mechanisms Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight-line motion mechanisms– Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms. **5**

UNIT III

Kinematics Synthesis of Planar Linkages: Movability of four bar linkages, Gershoff's law, Graphical methods of synthesis and Three position synthesis of four bar and slider crank mechanisms, Analytical method- Freudensten's equation for function generation (Three position) **7**

UNIT IV

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower. **7**

UNIT V

Gears: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear. **7**

Books and References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines-S.S. Rattan
6. Kinematics of Machines-Dr. Sadhu singh
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

[2438]: **MANUFACTURING SCIENCE- I** **L T P: 3 0 0**

Course Objective:

1. To familiarize students with the processes in correlation with material properties which change the shape, size and form of the raw materials.
2. To help the students to understand the requirements of conventional and unconventional manufacturing processes as per desirable conditions.

Course Outcomes:

1. Describe the principles and science of various basic manufacturing processes.
2. Plan and create jobs using various forming operations and also prepare a sheet metal jobs.
3. Gain fundamental knowledge and design widely used in casting and forming.
4. Select right method, techniques and manufacturing process for desired job.
5. Understand the application, advantages and limitations of various equipment and materials in manufacturing processes.

Unit-I

Introduction: Importance of manufacturing. Economic &technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items. **2**

Metal Forming Processes: Elastic & plastic deformation, yield criteria. Hot working vs cold working. Analysis (equilibrium equation method) of Forging process for loadestimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. **7**

Unit-II

Metal Forming Processes (continued): Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. **3**

Condition for Rolling force and power in rolling. Rolling mills & rolled-sections **2**

Design, lubrication and defects in metal forming processes **2**

Unit-III

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking vs Piercing. Compound vs Progressive die. Flat-face vs Inclined-face punch and Load(capacity) needed. **4**

Analysis of forming process like cup/deep drawing. Bending & spring-back. **3**

Unit-IV

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming. **2**

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications. **2**

Jigs & Fixtures: Locating & Clamping devices & principles. Jigs and Fixtures and its applications. **2**

Manufacturing of Plastic components: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives. **2**

Unit-V

Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design

considerations, Gating, Riser, Runners, Core. Solidification of casting, Sand casting, defects & remedies and inspection. Cupola furnace. **7**

Die Casting, Centrifugal casting. Investment casting, CO2 casting and Stir casting etc. **3**

Books:

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by P.C. Pandey
3. Production Technology by R.K. Jain
4. Manufacturing Technology by P.N. Rao., TMH
5. Materials and Manufacturing by Paul Degarmo.
6. Manufacturing Science by KM Moeed.
7. Manufacturing Engineering & Technology by Kalpakjian, Pearson Pub.

[2439] MEASUREMENT METROLOGY AND CONTROL L T P: 3 0 0

Course Objectives

1. To develop in students the knowledge of basics of Measurements, Metrology and measuring devices.
2. To understand the concepts of various measurement systems & standards with regards to realistic applications.
3. The application of principle of metrology and measurements in industries.
4. To develop competency in sensors, transducers and terminating devises with associated parameters
5. To develop basic principles and devices involved in measuring surface textures.

Course Outcomes

1. Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.
2. Identify the uses of gauges and comparators.
3. Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.
4. Understand measurement of field variables like force, torque and pressure.
5. Understand the fundamentals of thermocouple and strain measurement.

SYLLABUS

Unit-I: Mechanical Measurements

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. **4**

Sensors and Transducers: Types of sensors, types of transducers and their characteristics. **2**

Signal transmission and processing: Devices and systems. Signal Display & Recording Devices. **3**

Unit-II

Time related measurements: Counters, stroboscope, frequency measurement by direct comparison. **1**

Measurement of displacement **1**

Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures. **1**

Strain measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. **2**

Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. **1**

Temperature measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers. **2**

Vibration: Seismic instruments, vibration pickups and decibel meters, vibrometers accelerometers **2**

Unit-III:

Metrology and Inspection: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. **2**

Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microcrater. **2**

Limit gauges classification, Taylor's Principle of Gauge Design. **1**

Unit-IV

Measurement and Inspection: Dimensional inspection – Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection, Measurement of geometric forms like straightness, flatness, roundness. **2**

Tool makers microscope, profile project autocollimator. **1**

Interferometry: principle and use of interferometry, optical flat. **2**

Measurement of screw threads and gears. **1**

Surface texture: quantitative evaluation of surface roughness and its measurement. **1**

References:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963
5. Gupta, I.C., "Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, "Mechanical Measurement" New Age Publishers
7. Jain, R.K., "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers

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[2440] **ELECTRICAL MACHINE** **L T P: 3 0 0**

Course Objectives

The objective of this course is to impart

1. To expose the students to various electrical machines
2. To understand the specifications of electrical machines
3. To learn the basic of electrical machines
4. To introduce advances in electrical machine.

Course Outcomes

1. Understand the fundamentals of AC Machine windings and concepts pulsating and revolving magnetic fields.
2. Reproduce the construction and working principle of various types of three phase Induction motor.
3. Summarize different techniques related to speed control of three phase induction motor and associate the principles related to single phase induction motors.
4. Outline different types of Alternators and their performance criteria.
5. Identify different types of synchronous motors; interpret their performance under different load conditions.
6. To understand and apply the fundamentals of systematical components for the analysis of AC servo motor leading the design of its equivalent circuit and evaluation of its performance.
7. To learn about construction features, method of operation, characteristics and application of stepper motor.
8. Acquire the knowledge of fundamentals, construction details and classification of universal motors and synchronous motor like reluctance motors, hysteresis motors.
9. Acquire the knowledge of fundamentals, construction details and classification of linear.

SYLLABUS

Unit I- Introduction: Efficiency Voltage regulation, O.C.& S.C. Tests, Three phase transformer connections,3-phase to 2-phase or 6-phase connections and their applications, Volt- Amp relations, efficiency, advantages & disadvantages, applications, Concept of starting, speed control, losses and efficiency

Unit II- Three phase Induction Motor: Construction, equivalent circuit, torque equation, torque- slip characteristics, speed control, Alternator: Construction, E.M.F. equation, Voltage regulation, its determination by synchronous impedance method. 3 Synchronous Motor: Starting, effect of excitation on line current (V-curves), synchronous condenser. 2 Servo Motor: Two phase ac. servo motor & its application.

Unit III- Modeling of Mechanical System: linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems. Control System: Open loop & closed loop controls, servo mechanisms; concept of various types of system, Signals: Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics.

Unit IV- Time Response Analysis: Time response of a standard second order system, response specifications, steady state errors and error constants, Stability: Concept and types of stability,

Routh Hurwitz Criterion and its application for determination of stability, limitations; Polar plot, Nyquist stability Criterion, assessment of stability.

Unit V- Root Locus Techniques: Concept of root locus, construction of root loci., Frequency Response Analysis: Correlation between time and frequency responses of a second order system, Bode plot, gain margin and phase margin and their determination from Bode and Polar plots, Introduction to P, PI and PID controllers, characteristics, representation and applications.

Suggested Books

1 Prithwiraj Purkait, Indrayudh Bandyopadhyay Electrical Machines Oxford Publications
2 R.K. Agarwal Principles of Electrical Machine Design S K Kataria and Sons
3 Ashfaq Husain Electric Machines Dhanpat Rai & Co. (P) Limited

[20441] MANUFACTURING SCIENCE-I LAB L T P: 0 0 2

Experiments: minimum 8 experiments out of following.

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testings (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

Course Objective:

1. To Explain the pattern making
2. To prepare the concepts about forging
3. To perform the spot welding
4. To develop the practical knowledge about blacksmithing
5. To develop the concepts of blanking and punching.

Course Outcomes:

1. Upon completion of this course, the students will be able to understand and compare the functions and applications of blanking and punching.
2. To demonstrate the process of casting.
3. To learn how to perform spot welding for thin materials.
4. Upon completion of this course, the students can able to apply the different forging process
5. Learn surface finishing techniques.

[20442] **MEASUREMENT & METROLOGY LAB** **L T P: 0 0 2**

Experiments: Minimum 8 out of following.

1. Study & working of simple measuring instruments- Vernier caliper's, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sine bar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & tolerances
9. Study of Pressure & Temperature measuring equipment.
12. Strain gauge measurement.
13. Speed measurement using stroboscope.
14. Flow measurement experiment
15. Vibration/work measuring experiment.
16. Experiment on Dynamometers.

Course Objectives:

The objectives of this course are to:

1. Learn the principle on which different instruments operate and provide hands on experience on them.
2. Generate knowledge and skill in use of precision instruments.
3. Learn a basic understanding of various instruments used in linear and angular measurements.
4. Get familiarize with usage of tool makers microscope.
5. Learn a basic understanding of the instruments used for measurement of pressure, temperature, flow etc.

Course Outcomes: after successful completion of the course, students will be able to:

1. Create industry-wide engineering product quality standards.
2. Display your efforts to assure product quality by working in the quality control divisions of various companies.
3. Perform alignment tests and analyse the surface roughness measurement.
4. Gain proficiency in applying the principles of instruments and measurement methods.
5. Work on designing specialised gadgets and instruments for a specific purpose should be shown.

[20443] **MACHINE DRAWING – II LAB** **L T P: 0 0 2**

Review of Orthographic Projections (1 drawing sheet): Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views. **2**

Part and Assembly Drawing (2 drawing sheet): Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc. **2**

Specification of Materials (1 drawing sheet): Engineering materials, representation, Code designation of steel, copper, aluminium etc. **1**

Limits, Tolerance and Fits (1 drawing sheet): Limit system, Tolerances, Method of placing limit dimensions, Fits-types **2**

Surface Roughness (1 drawing sheet): Introduction, nomenclature, machining symbols, indication of surface roughness. **1**

Production Drawing (1drawing sheet): Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc. **2**

Computer Aided Drafting (2 drawings): Introduction, input, output devices, introduction to software like AutoCAD, ProE, basic commands and development of 2D and 3D drawings of simple parts. **3**

Books and References:

1. Machine Drawing - KL Narayana, P Kannaiah, KV Reddy - New Age
2. Machine Drawing - PS Gill - SK Kataria & sons
3. Machine Drawing -N. Siddeshswar, P Kannaiah, VVS Shastry -Tata McGraw Hill
4. Engineering Drawing - RK Dhawan - S. Chand
5. AutoCAD-S. Vshal - Dhanpat Rai
6. Engineering Graphics - BK Goel & PK Goel - SK Kataria
7. Computer Aided Engineering Graphics - Rajashekhar Patil - New Age
8. Engineering Drawing - Dhananjay A Jolhe - Tata McGraw Hill
9. Engineering Drawing - CM Agrawal - Tata McGraw Hill
10. Machine Drawing – Ajeet Singh – The Mc Graw Hill Companies

Course Objectives

1. To study the Engineering materials, representation, Code designation of steel, copper,
2. To understanding the basic commands and development of 2D and 3D drawing for simple machine parts.

Course Outcomes After completion of this course students will be able to:

1. Prepare production Drawing different types of machine elements such as helical gear, bevel gear, crank, connecting rod, belt pulley, piston.
2. Practice of part drawings and assembly drawing for machine components like eccentric, lathe tail stock, air valve, screw jack, connecting rod.
3. To understand the knowledge of limit, fits, tolerance and surface roughness.

[20444] **ELECTRICAL MACHINES LAB** **L T P: 0 0 2**

Minimum 8 out of following Experiments

1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single-phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine
   (a) speed- torque characteristics (b) power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using
   (a) Voltage Control (b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and unity, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load.

Course Objectives

1. To expose the students to various electrical machines
2. To understand the specifications of electrical machines
3. To learn the basic of electrical machines

Course Outcomes

1. Explain construction and operation principle of dc motors and dc generators.
2. Explain construction and operation principle of transformers.
3. Explain construction and operation principle of ac generators.
4. Explain the construction, features and operation principle of AC motors.

[3432] **MACHINE DESIGN – I** **L T P: 3 0 0**

Course Objective

1. To study different types of design consideration for static and dynamic loading
2. To teach students theories of failure and Standards designation of carbon & alloy steel.
3. To illustrate the design of mechanical components like shaft, key & coupling, rivet joints and mechanical springs.

Course Outcome

1. Explain the knowledge of basic requirements of machine elements and machines.
2. To obtain the knowledge of the basic design process and modes of failure.
3. To examine theories of failures for different machine component subjected to static load,
4. To understand static and fatigue loading of machine elements.
5. To understand the design of various types of powers screws.
6. Analysis the design of mechanical components such as Shaft, boiler joints, power screw, couplings
7. Analyze and identify the failure criteria of different kinds of springs under static and variable load.

SYLLABUS

UNIT I

Introduction: Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads **3**

Design against Static Load Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure **4**

UNIT II

Design against Fluctuating Loads Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch **4**
sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria Riveted Joints-Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint **4**

UNIT III

Shafts: Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity **4**

Keys and Couplings Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings Design of rigid and flexible couplings **4**

UNIT IV

Mechanical Springs: Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading **4**

Power Screws: Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack. **3**

Books and References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India

4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill

Note: Design data book is allowed in the examination

[3433] DYNAMICS OF MACHINE L T P: 3 0 0

Course objectives

1. To evaluate how much mass should be balanced between rotating and reciprocating machine components.
2. To comprehend gyroscope and governor principles.
3. To calculate the forces and power needed for dynamometer and brake calculations.
4. For mechanical systems, calculate the static and dynamic forces.
5. To comprehend the fundamentals of vibrations.

Course Outcomes:

1. Explain the knowledge of basic requirements of machine elements and machines.
2. To obtain the knowledge of the basic design process and modes of failure.
3. To examine theories of failures for different machine component subjected to static load,
4. To understand static and fatigue loading of machine elements.
5. To understand the design of various types of powers screws.
6. Analysis the design of mechanical components such as Shaft, boiler joints, power screw, couplings
7. Analyze and identify the failure criteria of different kinds of springs under static and variable load.

SYLLABUS

UNIT I

Static & Dynamic Force Analysis: Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkage **5**
D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis- Piston and crank effort. **3**

UNIT II

Balancing of Machines: Static and dynamic balancing, balancing of several masses in the same plane and different planes, balancing of reciprocating masses, balancing of primary force in reciprocating engine, Partial balancing of two-cylinder locomotives, Variation of tractive force, swaying couple, hammer blow. **7**

UNIT- III

Friction: Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure **5**
and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive. **7**

Brakes & Dynamometers (Mechanical Type): Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers **3**

UNIT III

Governors: Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, **8**
Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, Controlling force diagrams for Porter governor and Spring controlled governors. **4**

UNIT IV

Gyroscopic Motion: Principles, Gyroscopic torque, Effect of gyroscopic couple on the

stability of aero planes & automobiles. **3**

Mechanical Vibrations: Types of vibrations, Degrees of freedom, Single degree free & damped vibrations, Forced vibration of single degree system under harmonic excitation, Critical speeds of shaft. **4**

Books and References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines-S.S. Rattan
6. Kinematics of Machines-Dr. Sadhu singh
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

[3434] **MANUFACTURING SCIENCE-II** **L T P: 3 0 0**

Course objectives:

1. Metal cutting
2. Merchants force circle diagram.
3. Machining process.
4. operations.
5. Joining process.
6. Ability to Learn.
7. Imprecise knowledge of unconventional Machining.

Course Outcomes:

1. Explain and analyze cutting tool parameter in metal cutting process and also describe geometry of single point cutting tool;
2. Describe working principle of lathe, shaper, and planer, drilling, milling machines and explain the all parameters of twist drill;
3. Explain the significance and working of grinding operation and super finishing operations
4. Explain each welding process for joining metal and non-metal and also explain cause and consequences of welding defects by using thermodynamics and metallurgical aspect;
5. Analyze the non-conventional machining and welding process

SYLLABUS

Unit-I

Metal Cutting and Machine Tools: Metal Cutting Mechanics of metal cutting. Geometry of tool and nomenclature. ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting. **9**

Unit-II

Machine Tools: Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout. **2**

Shaper, slotter, planer: Construction, operations & drives. **1**

Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. **2**

Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills**.** **2**

Unit-III

Grinding & Super finishing

Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and ruing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. **4**

Super finishing: Honing, lapping, polishing. **1**

Standardization & Interchangeability, Limits, Fits & Tolerance and Surface roughness: Introduction to Standardization & Interchangeability Limits, Fits**,** Tolerances and IS standards, Limit-gauges, and surface-roughness. **3**

Unit-IV

Metal Joining (Welding): Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc.

Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing **8**

Thermodynamic and Metallurgical aspects in welding and weld, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. **2**

Unit-V

Introduction to Un-conventional Machining and Welding

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. **6**

Books

1. Manufacturing science by Ghosh and Mallik
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey
6. Modern Machining Processes by P.C. Pandey & H.S. Shan
7. Manufacturing science by Degarmo
8. Fundamentals of metal cutting & machine tools - Juneja & Shekhon
9. Process & materials of manufacturing - Lindburg.
10. Advanced Machining Process - VK Jain

[3435] **HEAT AND MASS TRANSFER** **L T P: 3 1 0**

Course objectives:

1. To understand the fundamental of heat transfer.
2. Analysis of heat transfer through conduction, convection, and radiation.
3. Application of heat transfer in various equipment used in industry.
4. Understanding the Mass transfer concept.
5. To understand boiling and condensation concepts.
6. Heat transfer analysis in various cases of convection.

Course Outcomes:

1. Learn the steady state and unsteady state conductive heat transfer.
2. Understand the principles of convection and its application
3. Understand the principles of radiation and its application
4. Learn the concepts of mass transfer
5. Learn the condensation and evaporation process in the atmosphere.

SYLLABUS

UNIT-I

Introduction to Heat Transfer: Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. **2**

Conduction: One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. Steady State one-dimensional.

Heat conduction: Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. **6**

UNIT-II

Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. **3**

Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. **4**

UNIT-III

Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. **4**

Natural Convection: Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection. **3**

UNIT-IV

Thermal Radiation: Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non-black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Greenhouse effect. **8**

UNIT-5

Heat Exchanger: Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness- NTU method; Compact heat exchangers. **3**

Condensation and Boiling: Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. **3**

Introduction to Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film. **2**

Books:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer by J.P. Holman, McGraw-Hill International edition.
3.Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

Note: Use of Data book is allowed in the examination.

[30436] **MACHINE DESIGN – I LAB** **L T P: 0 0 2**

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack

.

Course objective

1. To understand the design and drawing of machine elements.
2. To teach students theories of failure.

Course outcome: After completion of this course students will be able to:

1. To understand static and fatigue loading of machine elements.
2. Prepare the design and drawing of mechanical components.
3. Analyze and identify the failure criteria of different kinds machine elements.

[30437] **DYNAMICS OF MACHINE LAB** **L T P: 0 0 2**

Note: Eight experiments out of the following are to be conducted

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring-controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch.

Course Objectives

1. To determine the balancing of masses of rotating and reciprocating machine elements
2. To understand the principles of gyroscope and governors
2. To study working of brakes and dynamometer
3. To determine the moment of inertia of various mechanical systems
4. To understand the vibrational behavior of systems

Course outcome

1. Being able to use multiple linkages, mechanisms, and motors to balance diverse masses
2. Being able to use various governors and apply the concepts of gyroscopic effects and stabilization on different transport vehicles
3. Being able to comprehend how brakes and a dynamometer function
4. Being able to calculate the vibrational properties of various systems
5. Being able to calculate the gear and gear train speed reduction and enlargement used in machine.

[30438] **MANUFACTURING SCIENCE-II LAB** **L T P: 0 0 2**

min 8 experiments out of the following (or such experiment along-with study of the machines/processes)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints, HAZ.

Course objectives

1. Metal Cutting
2. Machine Tools
3. Non-Traditional Machining Process

Course Outcomes:

1. Upon completion of this course, the students will be able to understand and compare the functions and applications of different metal cutting tools.
2. To demonstrate the working of Lathe Machine.
3. To demonstrate the working of shaper machine.
4. Upon completion of this course, the students can able to apply the different metal removing, finishing and super finishing and for component production.
5. Learn surface finishing techniques.

[30439] **HEAT & MASS TRANSFER – LAB** **L T P: 0 1 2**

Minimum 10 experiment of the following

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

Course Objectives

1. In order to establish approaches for addressing a wide range of real-world engineering challenges, this course is meant to introduce a fundamental study of the phenomena of heat and mass transfer.
2. Experiments are intended to illustrate the computation of performance using temperature field measurement and the basic principles of mass and heat transmission.
3. By monitoring a few engineering parameters, the performance of heat exchangers and extended surfaces under various operating situations is assessed.

Course outcome

1. Perform steady state conduction experiments to estimate thermal conductivity of different materials for plane, cylindrical and spherical geometries.
2. Perform the transient heat conduction experiment and obtain variation of temperature along the length of the pin fin.
3. Estimate heat transfer coefficients in forced convection, free convection and determine effectiveness of heat exchangers.
4. Perform radiation experiments: determine surface emissivity of a test plane and Stefan-Boltzmann's constant and compare with the critical values.
5. Estimate heat transfer coefficients in condensation, boiling and effectiveness of heat pipe

[3436] OPERATONS RESEARCH L T P: 3 1 0

Course objectives:

1. Define and formulate linear programming problems and appreciate their limitations.
2. Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
3. Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.
4. Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.
5. Effectively communicate ideas, explain procedures and interpret results and solutions in written and electronic forms to different audiences.

Course Outcomes:

1. Use the proper methods and optimization solvers to solve linear programming problems, then analyse the solutions.
2. Find the first fundamental viable and optimal solution to the transportation difficulties, minimise the cost of shipping things from the source to the destination, and maximise the revenues of delivering products utilizing various techniques.
3. Utilize multiple approaches to effectively allocate resources to Demand points, and reduce the cost or time it takes to complete a certain number of jobs divided by the number of people.
4. Model competitive processes in the real-world using ideas from game theory. Analyse games with pure and mixed strategies.
5. Create network models for industrial and service systems, then use operations research methods and algorithms to tackle these network issues.

SYLLABUS

Unit-I

Introduction: Linear Programming Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem sensitivity analysis.

Unit-II

Transportation & Assignment problems Deterministic Dynamic Programming Multistage decision problems & solution, Principle of optimality.

Unit-III

Decision theory: Decision under various conditions

Game Theory: Two Person Zero sum game, Solution with/without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Liner Programming **Sequencing** Basic assumption, n Jobs through two / three machines, Jobs on m machines.

Unit-IV

Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy

Unit-V

Simulations: Use, advantages& limitations, Monte-carlo simulation, Application to queuing, inventory & other problems

Queuing models: Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration

Text Books

Operations Research by: Wangner
Operations Research by: Taha
Introduction to Management Science by: Hiller & Hiller
Operations Research by: Wayne L. Winston

[3437] **I C ENGINES** **L T P: 3 0 0**

Course Objectives

1. To impart knowledge about basic ideas of IC engines,
2. To impart knowledge about fuels and combustion,
3. To impart knowledge about lubrication and cooling
4. To impart knowledge about testing,
5. To impart knowledge about and ideas about compressors and superchargers

Course Outcomes:

1. Understand engines, air standard cycles and their analysis, and also to acquire Knowledge of fossil and alternative fuels for IC engine and testing of IC engines. Pollution and its control for IC Engines.
2. To evaluate the combustion system and combustion chamber design for SI engines. Also, to understand the ignition system and Carburetion for otto cycle.
3. Understand the combustion system for diesel engines. Also, to understand the fuel injection system.
4. Understand the cooling, lubrication and supercharging systems.
5. For understanding the compressors their classification and to analyze their performance.

SYLLABUS

Unit-I

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Stirling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. **4**

Testing and Performance: Performance parameters, Basic measurements, blow by measurement, Testing of SI and CI engines. **2**

Unit–II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. **2**

Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI Ignition system requirements, Magneto and battery ignition systems, ignition timing spark plug, electronic ignition. **4**

Unit–III

CI Engine: Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines. **2**

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. **3**

Scavenging in 2 Stroke engines, pollution and it's control. **2**

Unit-IV

Engine Cooling: Different cooling systems, Radiators and cooling fans. **1**

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. **2**

Supercharging: Effect of altitude on power output, Types of supercharging **1**

Unit-V

Compressors: Classification, Reciprocating compressors, Single and Multi-stage compressors, Intercooling, Volumetric efficiency. **2**

Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor. **2**

Books:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO
2. IC Engines, by Rogowsky, International Book Co.
3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata Mc Graw Hill Pub.

[3438] **MACHINE DESIGN-II** **L T P: 3 0 0**

Course Objectives:

1. The capacity to use the principles of stress analysis, theories of failure, and material science in the design of machine components will be demonstrated by the students. The students will exhibit the capacity to formulate sound hypotheses and carry out sound analysis while utilizing a variety of mechanical engineering topic areas.
2. Students will accurately complete the following tasks to demonstrate the abilities mentioned above:
3. The selection of bearing types, and sizing and analysis of rolling element bearings
4. The selection of gear types, sizing, analysis, and material selection of gear systems
5. The selection, sizing, design, and analysis of other mechanical components/systems

Course outcome:

1. Understanding the standard nomenclature, forces, failures, applications, design technique, and geometry under a specific loading condition for Spur and Helical gears.
2. Understanding the design process, forces, failures, and standard terminology Worm gears.
3. Understanding the various bearing types, their uses, failures, and design processes for sliding contact bearings and ball bearings (as per manufacturer catalogs), as well as determining the standard design processes for bearings under various loading conditions utilizing design data handbooks.
4. To understand the design process of different parts of the IC engine (engine cylinder, piston connecting rod, crank, and crankshaft) and determine the safe design of parts under given conditions by using design data hand book.

SYLLABUS

UNIT I

Spur Gears: Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **5**

UNIT II

Helical Gears: Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears. **3**

UNIT III

Worm Gears: Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing **3**

UNIT IV

Sliding Contact Bearing: Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing, **5**

Rolling Contact Bearing: Advantages and disadvantages, Types of ball bearing, thrust ball bearing, types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable

loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing **6**

UNIT V

IC Engine Parts: Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of Centre crankshaft **6**

Books and References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

[3439] **FLUID MACHINARY** **L T P: 3 0 0**

Course objectives:

1. To enable the graduates to understand the basics of hydraulics.
2. Improve student's knowledge and skills on hydraulic pumps and various power supply sources.
3. To make student understand about the hydraulic turbines and accumulators.
4. Introduce students to various kind of hydraulic machinery.

Course Outcomes:

1. Understand the basics of the hydro machinery and the components.
2. Describe and understand the functions and use of different types of turbines and pumps.
3. Identify and describe various types of hydraulic turbines, pumps and hydraulic machinery.
4. Describe constructional details of centrifugal and reciprocating pumps.
5. Calculate the hydraulic parameters and select the required hydraulic machine (pump).

SYLLABUS

UNIT-I

Introduction: Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation. **4**

Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface flat & curve), Effect of inclination of jet with the surface. **2**

Hydraulic Turbines: Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. **2**

UNIT-II

Reaction Turbines: Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines. **8**

UNIT-III

Centrifugal Pumps: Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics. **7**

UNIT-IV

Positive Displacement Pumps: Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics. **6**

UNIT-V

Other Machines: Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics. **6**

Water Lifting Devices: Hydraulic ram, Jet pumps, Air lift pumps. **4**

Books:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
2. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
   Applied Hydraulics by Addison
3. Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
4. Hydraulic Machines by D S Kumar

[3440] REFRIGERATION & AIR CONDITIONING L T P: 3 0 0

Course Objectives:

1. To recall the basic refrigeration system and application.
2. To make students understand the refrigeration cycle.
3. To make students understand the refrigeration equipment and its uses.
4. To make students apply the concept of basic refrigeration process

Course Outcomes:

After the completion of this course the student will be able to:

1. Recall the fundamental of refrigeration system and process
2. Understand the basic concept of method of refrigeration.
3. Understand the basic need of different refrigeration cycle.
4. Different configuration of multistage system using refrigerant
5. Elementary knowledge of refrigeration & air conditioning equipment.

Unit-I

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART). **8**

Unit-II

Vapour Compression System: Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage System, Cascade system. **8**

Unit-III

Vapour Absorption system: Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy concentration diagram, Adiabatic mixing of two streams, Ammonia Water vapour absorption system, Lithium Bromide water vapour absorption system, **5**

Comparison Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. **3**

Unit-IV

Air Conditioning: Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). **8**

Unit-V

Refrigeration Equipment & Application: Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, **7**

Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning. **4**

Books:

1. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
2. Refrigeration and Air conditioning by C.P Arora.
3. Refrigeration and Air conditioning by Arora & Domkundwar.
4. Refrigeration and Air conditioning by stoecker & Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Refrigeration and Air conditioning by P.L. Baloney.
7. Thermal Environment Engg. By Kuhen, Ramsey & Thelked.

[30441]: MACHINE DESIGN-II LAB L T P: 0 0 2

Course Objective

1. To develop and use of analytical ability in C and C++
2. To apply concept of strength of material on mechanical component
3. To use of mechanical engineering concept and compete mini project.

Course outcome:

1. Be able to apply design knowledge for the Design of different types of machine elements and their design procedure with c program.
2. Develop Logical and Analytical ability in C and C++ and apply knowledge of the language for the design of various machine elements.
3. One design Mini-Projects is required to submit by student to develop and apply knowledge of Machine Design and drafting software for any product or design system on basis of: (1) idea generation, (2) Creativity, Reliability and safety, (3) bounding solutions (4) Ergonomic Considerations (5) Use of International standard

Practical Syllabus

A. Computer and Language: students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme (3practical turns)

B. Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject (5practical turns)

C. Mini Project: Each student will be given a real-life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

[30442] FLUID MACHINERY LAB L T P: 0 0 2

Minimum 8 experiments from following

1. Impact of Jet experiment.
2. Turbine experiment on Pelton wheel.
3. Turbine experiment on Francis turbine.
4. Turbine experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through detailed visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aero foil in wind tunnel.

Objective:

1. Student able to learn about different characteristics of different types turbines.

2. Student able to learn about different characteristics of pumps.

3. Student able to learn about concept of impact of jet.

Course outcomes

1. Get Exposure to verification of Bernoulli's Theorem.

2. Evaluate the efficiency of Pelton turbine.

3. Evaluate the hydraulic ram and reciprocating pump's efficiency.

4. Evaluate the centrifugal pump's effectiveness.

[30443] REFRIGERATION & AIR CONDITIONING LAB L T P: 0 0 2

Minimum 8 experiments out of following;

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig &calculation of various performance parameters.
6. To study air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressors for determination of volumetric efficiency, PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

Objective:

1. The examination of various refrigeration cycles and the evaluation of performance utilising Mollier charts and/or tables of refrigerant properties.

2. Comparative analysis of the characteristics, uses, and environmental concerns of several refrigerants.

3. Recognize the fundamental air conditioning procedures on psychometric charts, and compute the cooling load for use in both residential and commercial air conditioning.

Course outcomes

1. Learn the fundamental elements of a refrigeration system, then calculate the performance of various setups.

2. Become knowledgeable about the fundamental elements of air conditioning and look at how psychometric procedures affect the efficiency of air conditioners.

3. Become familiar with air washer applications and psychometric procedures.

4. Compute the volumetric efficiency and gain knowledge of the air compressor's thermodynamic cycle.

[4431] COMPUTER AIDED DESIGN (CAD) L T P: 3 1 0

Course objective:

1. Impart knowledge of computer aided design (CAD) techniques.
2. To teach the principles of parametric modelling so that students may design and modify geometric models using curves, surfaces, and solids.
3. Providing the principles of parametric modelling for the creation and manipulation of geometric models using curves, surfaces, and solids.
4. Demonstrate fundamental AutoCAD software concepts.
5. Utilize fundamental principles to create construction (drawing) methods

Course outcomes:

Students will be able to:

1. Use the strength and accuracy of AutoCAD as a drafting and design tool utilized in the mechanical design and manufacturing industries after completing the course.
2. Use fundamental CAD principles to build precise 2D geometry using the production of simple geometric constructs.
3. Produce, modify, and edit 2D illustrations and figures.
4. Implement mechanical drafting principles, with a focus on ANSI industry standards, in projects by using layers, dimensions, drawing formats, and 2D figures.

SYLLABUS

UNIT-I

Introduction: Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications. **4**

Computer Graphics-I: CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters. **5**

UNIT-II

Computer Graphics-II: Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm. **4**

Geometric Transformations: World/device Coordinate Representation, Windowing and clipping, 2 D Geometric Transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation. **4**

UNIT-III

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves- Hermite cubic splines-Blending function formulation and its properties, Bezier curves- Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves. **8**

UNIT-IV

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid

modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models Application commands for AutoCAD & ProE software. **8**

UNIT-V

Numerical Methods: Introduction, Errors in numbers, Binary representation of numbers, Root finding Bisection method, Newton Raphson method, Curve fitting- Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method. **4**

Finite Element Method: Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element). **4**

Books & References:

1. Computer Graphics Hearn & Baker Prentice Hall of India
2. Computer Aided Engineering Design Anupam Saxena & B. Sahay Anamaya Publishers
3. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
4. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill
5. Computer Aided Design RK Srivastava Umesh Publications
6. Mathematical Elements for Computer Graphics DF Rogers & JA Adams McGraw Hill
7. Finite Element Method SS Rao
8. FE Analysis Theory and Programming CS Krishnamoorthy Tata McGraw Hill
9. Numerical Method for Engg Computation MK Jain, SRK Iyenger & RK Jain Wiley Eastern Limited
10. Computer Oriented Numerical Methods V Rajaraman Prentice Hall of India

[4432] COMPUTER AIDED MANUFACTURING (CAM) L T P: 3 0 0

Course objectives

1. To Study the knowledge on various computer-based programming in machining operations.
2. To study the knowledge of CNC based machining operations such as turning, milling and drilling.

Course Outcomes:

1. To obtain knowledge about the NC, CNC, & DNC technology used in production system.
2. To Brief knowledge about GT, Transfer line, CAPP, CIM, FMS and Robotic configuration.
3. Students will get knowledge about the various programming language used in CNC machines.
4. Students understanding of ordinary and NC machine tools.
5. To obtain knowledge of Automation and Social economic impacts of automation.
6. To understand the knowledge of system devises and concepts of mechatronics.

SYLLABUS

UNIT-I

Automation

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. **4**

Features of NC Machines- Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity. **3**

UNIT-II

NC Part Programming- **5**

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; canned cycles, Subroutine, and Macro.

(b) APT programming. Geometry, Motion and Additional statements, Macro statement. **4**

UNIT-III

System Devices

Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators

Digital differential Integrator- Principle of operation, exponential declaration; DDA.

Hardware Interpolator- Linear, Circular; DDA Software Interpolator. **4**

Control of NC Systems: Open and closed loops. Control of point-to-point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control. **3**

UNIT-IV

Computer Integrated manufacturing system: Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection. **6**

UNIT-V

Robotics: Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples. **6**

Intelligent Manufacturing: Introduction to Artificial Intelligence for Intelligent manufacturing. **2**

Books/References

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
2. Computer Aided Manufacturing by Kundra and Rao
3. Computer control of manufacturing systems by Koren
4. NC Machine Tools by S.J. Martin.
5. NC Machines by Koren
6. CAD/CAM by Groover.

[4433]: AUTOMOBILE ENGINEERING L T P: 3 0 0

Course objectives:
To understand and apply the knowledge about various automotive systems, subsystems, their interrelationship and their functions.

Course Outcomes:

1. To obtain knowledge of various components of engine
2. Calculate the various designing components
3. Students will be able to know about different types of automobile structure
4. To Brief knowledge of components and its repairing

SYLLABUS

Unit-I
Power Unit and Gear Box: Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination. Design of Gear box **7**

Unit-II
Transmission System: Requirements. Clutches. Toque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc. Steering geometry. Ackerman mechanism, Understeer and Oversteer. **8**

Unit-III
Braking System: General requirements, Road, Tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. **4**
Chassis and Suspension System: Loads on the frame. Strength and stiffness. Various suspension systems. **3**

Unit-IV
Electrical System: Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc. **5**
Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI. **4**

Unit-V
Automobile Air Conditioning: Requirements, Cooling & heating systems Cooling & Lubrication System: Different type of cooling system and lubrication system. Maintenance system: Preventive maintenance, break down maintenance and over hauling. **8**

References Books
1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
5. Automobile Engineering - Newton and Steeds.

[40449] CAD/CAM LAB L T P: 0 0 2

Course Objectives

To the understanding theoretical and practical knowledge of CAD/CAM software. This course also discusses Different types of programming languages.

Course Outcomes

1. Writing and validation of program for root finding and curve fitting by MATLAB.
2. writing and validation of program for line and circle drawing by C language
3. will get knowledge about different types of command using in Auto Cad.
4. Create Manual part program and APT programs for manufacturing various parts on CNC Lathe.

TEN Experiments are to carried out. FIVE Experiments each from CAD and

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feedback devices
9. Experiment on Mecatronics and controls

[40450] AUTOMOBILE ENGG. LAB L T P: 0 0 2

Course objectives:
Practical knowledge of automobile engineering lab its help to understand about various automotive systems, subsystems their functions and coordination.

Course Outcomes:
1. To identify the components of IC engines and assemble and dissemble the parts
2. Identify viable alternate fuels for SI and CI engines
3. Students will be able to know about different types of automobile structure
4. To Brief knowledge of components and its repairing
5. Explain and discuss combustion and emissions in IC Engines

Minimum 10 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

[4451] POWER PLANT ENGINEERING L T P: 3 1 0

Course Objective:

1. Discuss the economics of power plants and identify the variables that affect plant selection.
2. Explain about the many parts of a steam power plant and the elements that contributed into selecting a location for the plant.
3. Describe how the component of a diesel power plant operates and compare it with a steam power plant.
4. Describe how a gas turbine power plant and its components operate.
5. Describe the elements, fundamental ideas, and operation of nuclear and non-conventional power plants.
6. Describe the electrical, instrumentation, and pollution control systems that are employed in power plants.

Course Outcomes:

1. Able to get the fundamental knowledge of Power Plants.
2. Able to get the idea about the power generation by renewable and non-renewable energy resources.
3. Able to understand the various cycles and natural resources used in power plants, as well as how they are utilized.
4. Able to understand the components, principles and working of nuclear & non-conventional power plant.
5. Understanding the economics involved in Power Plant and identify the factors related to selection of plant.

SYLLABUS

Unit-I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. **3**

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant Units. **2**

Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. **3**

Unit-II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of steam power plant. **8**

Unit-III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site

selection of diesel power plant, Comparative study of diesel power plant with steam power plant. **2**

Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant. **6**

Unit-IV

Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, nuclear waste disposal, Site selection of nuclear power plants. **3**

Hydroelectric station: Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. **4**

Non-Conventional Power Plants: Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc. **2**

Unit-V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. **2**

Instrumentation: Purpose, classification, selection and application, recorders and their use, listing of various control rooms. **3**

Pollution: Pollution due to power generation. **2**

Books/References

1. “Power Plant Engineering” F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. “Power Plant Engineering” Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. “Power Plant Technology” El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

[4452]: MECHANICAL SYSTEM DESIGN L T P: 3 0 0

Course objectives:

This subject will emphasis engineering design with a focus on designing a system rather than the individual components of a system. Quality management systems, lean techniques and lifecycle assessment will be applied to the proposed product or service to understand system variability, maximize and maintain value-creation and assess environmental impacts.

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Course Outcomes:

1. Identify, interpret and analyses problems from an engineering perspective as well as also consider the relevant social, cultural, environmental, legislative, ethical and business factors.
2. Utilise creative problem-solving methodologies, decision-making and design skills to develop innovative concepts, products, services and solutions.
3. Select and utilize appropriate computer modelling techniques and experimental methods, whilst ensuring model or test applicability, accuracy and limitations of the methods.
4. Apply industry standard project management tools and practices.
5. Generate findings in both written and verbal formats and critique and evaluate the work of others. with the help of case study

SYLLABUS

UNIT-I

Engineering process and System Approach: Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, **4**
Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system **4**

UNIT-II

System Theories: System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, a case study-automobile instrumentation panel system. **4**
System modelling: Need of modelling, Model types and purpose, linear systems, mathematical modelling, concepts, A case study compound bar system. **4**

UNIT-III

Graph Modelling and Analysis: Graph Modelling and analysis process, path problem, Network flow problem, A case study: Material handling system **4**
Optimization Concepts: Optimization processes, Selection of goals and objectives- criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system **3**

UNIT-IV

System Evaluation: Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system Calculus Method for Optimization: Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system. **4**

UNIT-V

Decision Analysis: Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery **4**

System Simulation: Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: inventory control in production plant **5**

Books/References

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-SS Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

[4453] PROJECT MANAGEMENT L T P: 3 0 0

Course objective:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. To make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Outcomes

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analysis-Market, Technical, Financial and Economic.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Understand the contract management, Project Procurement, Service level Agreements and productivity.
5. Apply the risk management plan and analyse the role of stakeholders

SYLLABUS

UNIT-I

Project Management Concepts: Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction **8**

UNIT-II

Project Organization & Project Contracts: Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors. **8**

UNIT-III

Project Appraisal & Cost Estimation: Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis. **8**

UNIT-IV

Project Planning & Scheduling: Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event-oriented networks, updating of networks, LOB technique. **8**

UNIT-V

Modification & Extensions of Network Models: Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution. Precedence networking- examples with algorithm, decision

networks, probabilistic networks, and computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections. **8**

Books:

1. Project Management by K. Nagarajan
2. Project Management by Harvey Maylor

ELECTIVE-1:

[4434] UNCONVENTIONAL MANUFACTURING PROCESSES L T P: 3 0 0

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes & its classification and its future possibilities. **5**

Unit-II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, electrochemical machining, ultrasonic machining, Abrasive jet machining etc. **8**

Unit-III

Unconventional Machining Process (continued): Principle and working and application of unconventional machining processes such as Laser beam machining, **8**
Electron beam machining, Ultrasonic machining etc. (these can also be used for welding).

Unit-IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metalizing, Plasma are welding/cutting etc **7**

Unit-V

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, **7**
Electro Discharge forming, water hammer forming, explosive compaction etc

Electronic-device Manufacturing: Brief description of Diffusion and Photo-Lithography process for electronic-device manufacturing. **3**

Books

1. Modern Machining Processes – P.C. Pandey
2. Unconventional Machining – V.K. Jain

[4435] PRODUCT DEVELOPMENT AND DESIGN L T P: 3 0 0

Unit-I:

Introduction to Product Design: Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology-based developments. Physical reliability & Economic feasibility of design concepts. **7**

UNIT-II

Morphology of Design: Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, colour. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist. **7**

UNIT-III

Transformations: Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis. **9**

UNIT IV

Reliability: Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability. **7**
consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. Anthropometric data and its importance in design. Applications of Computers in product design. **4**

UNIT IV

Product Appraisal: Information and literature search, patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting. **8**

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe. Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
7. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
8. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H lurscheim, The Design Council - London.
10. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.

B.Tech. (Mechanical Engineering)

Program Specific Outcomes (PSO)

PSO 1: Learning to apply knowledge of fundamental of science, mathematics engineering basics of all fields to the conceptualization of engineering models.

PSO 2: To Identify, formulate, research literature and solve complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.

PSO 3: To find out Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PSO 4: Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PSO 5: Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

PSO 6: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PSO 7: Convey effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PSO 8: To manifest understanding of the societal, health, safety, legal

and cultural issues and the consequent responsibilities relevant to engineering practice.

PSO 9: Understand and commit to professional ethics and responsibilities and norms of engineering practice.

PSO 10: To Understand and acknowledge the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.

PSO 11: Demonstrate a knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations.

PSO 12: Identify the need for, and have the ability to engage in independent and life-long learning.

DEPARTMENT OF MECHANICAL ENGGINEERING

SYLLABUS

For 1st Year

MA-1841: MATHEMATICS –I L T P
3 1 0

Unit- I: Differential Calculus- I

Leibnitz theorem, Partial differentiation, Eulers theorem, Curve tracing, Change of variables, Expansion of function of several variables.

Unit – II: Differential Calculus-II

Jacobian, approximation of errors, Extrema of functions of several variables, Lagranges method of multipliers (Simple applications).

Unit – III: Matrices

Elementary row and column transformation Rank of matrix, Linear dependence, consistency of linear system of equations and their solution, Characteristic equation, Caley-Hamition theorem, Eigen values and eigen vectors, Diagonalisation, Complex and unitary matrices, Application of matrices to engineering problems.

Unit – IV: Multiple Integrals

Double and triple integral, Change of order, Change of variables, Beta and Gamma functions, Application to area, volume, Dirichlet integral and applications.

Unit – V: Vector Calculus

Point function, Gradient, divergence and curl of a vector and their physical interpretations, Line, surface and volume integrals, Statement and problems of Green's, Stoke's and Gauss divergence theorems (without proof).

Test Books:

1. B.V.Ramana, Higher Engineering Mathmatics, Tata Mc Graw-Hill Publishing Company Ltd., 2008.
2. R.K.Jain & S.R.K.Iyenger, Advance Engineering Mathematics, Narosa Publishing House, 2002.

Reference Books:

1. B.S.Grewal, Engineering Mathematics, Khanna Publishers, 2004.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
3. E.Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
4. C.Ray Wylie & Louis C. Barrett, Advanced Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd. 2003
5. Peter V. O'Neil, Advanced Engineering Mathematics, Thomson (Cengage) Learning, 2007.

PH-1843: ENGINEERING PHYSICS-I L T P
2 1 0

Unit - I Relativistic Mechanics:

Inertial & non-inertial frames, Michelson- Morley experiment, Einsteins postulates. Lorentz transformation equations. Length contraction & Time dilation, Addition of velocities; Variation of mass with velocity Mass energy equivalence. 06 Hrs.

Unit - II Optics:

Interference- Interference of light, Biprism experiment, displacement of fringes, Interference in thin films- wedge shaped film, Newton's rings Diffraction- Single, Double & N- Slit, Diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating. 10 Hrs.

Unit -III

Polarization- Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Fresnel's theory of optical activity, Polarimeters.

Laser: Spontaneous and stimulated emission of radiation, Einstein's Coefficients, construction and working of Ruby, He-Ne lasers and laser applications.

08 Hrs.

Unit – IV

Fiber Optics and Holography- Fundamental ideas about optical fiber, Types of fibers, Acceptance angle and cone, Numerical aperture, Propagation mechanism and communication in optical fiber.

Attenuation, Signal loss in optical fiber and dispersion. Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography. 06 Hrs.

Reference Books:

1. Concepts of Modern Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special theory of Relativity - Robert Resnick (Wiley)
3. Optics - Ajoy Ghatak (TMH) - Brijlal & Subramanian (S. Chand)
4. Optical Fibre & Laser - Anuradha De. (New Age)
5. Fundamental of Physics - Resnick, Halliday & Walker (Wiely)
6. Principles of Physics - R.A. Serway & J.W. Jewett

CY-1858: ENGINEERING CHEMISTRY

L T P
3 1 0

UNIT-I CHEMICAL BONDING AND STATES OF MATTER

M.O. theory and its applications in diatonic molecules. Hydrogen bond, metallic bond and their applications. Various states of matter including liquid crystallite state, classification and applications of liquid crystals. Types of unit cell, space lattice (only cubes, Bragg's Law. Calculation and density of the unit cell, one and two dimensional solids such as graphite and its conduction properties. Fullerenes and their applications.

UNIT-II REACTION KINETICS, PHASE RULE AND ELECTROCHEMISTRY

Order and molecularity of reactions, Zero order, first order and second order reactions. Integrated rate equations. Theories of reaction rates. Phase rule and its applications to one component system (water). Equilibrium potential, electrochemical cells, galvanic and concentration cells, electrochemical theory of corrosion and protection of corrosion. Fuel cells.

UNIT-III STRUCTURAL AND MECHANISTIC CONCEPTS OF ORGANICS

Inductive, electromeric mesomeric and hyperconjugative effects. Stability of reaction intermediates e.g. carbocation and free radicals. Mechanism of nucleophilic substitutions. Mechanism of the following reactions:

(i) Aldol condensation (ii) Cannizaro reaction
(iii) Beckman rearrangement (iv) Hoffmann rearrangement and
(v) Diels-Alder reaction.

E-Z nomenclature, R.S. configuration, optical isomerism, chirality and its implications, conformations of butene.

UNIT-IV POLYMERS AND ORGANOMETALLICS

Polymerization and its classification. Thermoplastic and Thermosetting resins. Eleastomers and synthetic fibres. Ion exchange resins. Organic conducting and biodegradable polymers. Classification and general methods of synthesis of organics and their applications in polymerizations and catalysis.

UNIT-V ANALYTICAL METHODS AND FUELS

Titrimetric analysis with reference to acid-base, redox, precipitations and complexometric titrations. Elementary ideas and simple applications of u.v., visible, infra-red and HNMR spectral techniques. Water treatment methods for boiler feed water by calgon process, zeolites and ion-exchange Classification of fuels. Analysis of coal, determination of colorific values. Biomass and biogas.

Text Books:

1. Advanced Inorganic Chemistry, by Cotton, F.A., Wilkinson G., Murrillo, C.A. and Bochmann, Wiley, ehichester, 1999.
2. March's Advanced Organic Chemistry : Reactions, Mechanisms and Structure Smith, Michael B./March, Jerry, John Willey & sons, 6th Edition, 2007.
3. Elements of Physical Chemistry, Glasstonne, Samuel B. ELBS, 2005.
4. Organic Chemistry, Finar, I.L. : Addision – Wesley Longman, Limited, 2004.

Reference Books:

1. Text Book of Polymer Science by F.W. Billmeyer, John Wiley & sons, 1994.
2. Liquid Crystals and Plastic Crystals, vol.-I, edited by G.W. Gray and P.A. Winsor, Ellis Harwood Series in Physical Chemistry, New York.
3. Corrosion Engineering by M.G. Fontana McGraw Hill Publications.

ME-1845: ENGINEERING MECHANICS **L T P**

3 1 0

UNIT- I

Two Dimensional Force Systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position , Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

Friction: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Application.

UNIT- II

Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

Trusses: Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.

UNIT- III

Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

UNIT- IV

Kinematics of Rigid Body: Introduction, Plane Motion of Rigid Body, Velocity and Acceleration under Translation and Rotational Motion, Relative Velocity.

Kinetics of Rigid Body: Introduction, Force, Mass and Acceleration, Work and Energy, Impulse and Momentum, D'Alembert's Principles and Dynamic Equilibrium.

UNIT V

Simple Stress and Strain: Introduction, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.

Pure Bending of Beams: Introduction, Simple Bending Theory, Stress in beams of different cross sections.

Torsion: Introduction, Torsion of shafts of circular section, torque and twist, shear stress due to torque.

Text Books:

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall
2. Mechanics of Solids by Abdul Mubeen, Pearson Education Asia.
3. Mechanics of Materials by E.P.Popov, Prentice Hall of India Private Limited.

EE-1860: ELECTRICAL ENGINEERING L T P
3 1 0

UNIT-I

D C Circuit Analysis and Network Theorems: Circuit Concepts: Concepts of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, R, L and C as linear elements, source transformation.

Kirchhoff's laws; loop and nodal methods of analysis; star-delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem (simple numerical problems).

UNIT-II

Steady- State Analysis of Single Phase AC Circuits: AC Fundamentals: Sinusoidal, square and triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel and series-parallel RLC Circuits: apparent, active & reactive powers, power factor, causes and problems of low power factor, power factor improvement; resonance in series and parallel circuits, bandwidth and quality factor (simple numerical problems).

UNIT-III

Three Phase AC Circuits: Three phase system-its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply and balanced load, line and phase voltage/current relations, three-phase power and its measurement (simple numerical problems).

Measuring Instruments: Types of instruments, construction and working principles of PMMC and moving iron type voltmeters & ammeters, single phase dynamometer wattmeter and induction type energy meter, use of shunts and multipliers (simple numerical problems on energy meter, shunts and multipliers).

UNIT-IV

Introduction to Power System: General layout of electrical power system and functions of its elements, standard transmission and distribution voltages, concept of grid (elementary treatment only).

Magnetic Circuit: Magnetic circuit concepts, analogy between electric & magnetic circuits, magnetic circuits with DC and AC excitations, magnetic leakage, B-H curve, hysteresis and eddy current losses, magnetic circuit

calculations, mutual coupling. Single Phase Transformer: Principle of operation, construction, e .m. f. equation, equivalent circuit, power losses, efficiency (simple numerical problems), introduction to auto transformer.

UNIT-V

Electrical Machines: Principles of electro mechanical energy conversion, DC machines: types, e. m. f. equation of generator and torque equation of motor, characteristics and applications of dc motors (simple numerical problems).

Three Phase Induction Motor: types, Principle of operation, slip-torque characteristics, applications (numerical problems related to slip only).

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Text Books:

1. V.Del Toro, "Principles of Electrical Engineering" Prentice Hall International
2. I.J. Nagarath, " Basic Electrical Engineering" Tata McGraw Hill
3. D.E. Fitzgerald & A. Grabel Higginbotham, " Basic Electrical Engineering Mc- Graw Hill

Reference Books:

1. Edward Hughes," Electrical Technology" Longman
2. T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press.
3. H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
4. W.H. Hayt & J.E. Kennely, "Engineering Circuit Analysis" Mc Graw Hill.

CS-1847: COMPUTER CONCEPTS AND PROGRAMMING IN C L T P
3 1 0

UNIT -I

Introduction to any Operating System [Unix, Linux, Windows], Programming Environment, Write and Execute the first program, Introduction to the Digital Computer; Concept of an algorithm; termination and correctness.

Algorithms to programs: specification, top-down development and stepwise refinement. Introduction to Programming, Use of high level programming language for the systematic development of programs. Introduction to the design and implementation of correct, efficient and maintainable programs, Structured Programming, Trace an algorithm to depict the logic, Number Systems and conversion methods

UNIT -II

Standard I/O in "C", Fundamental Data Types and Storage Classes: Character types, Integer, short, long, unsigned, single and double-precision floating point, storage classes, automatic, register, static and external, Operators and Expressions: Using numeric and relational operators, mixed operands and type conversion, Logical operators, Bit operations, Operator precedence and associativity.

UNIT-III

Conditional Program Execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch, Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue, Modular Programming: Passing arguments by value, scope rules and global variables, separate compilation, and linkage, building your own modules.

UNIT-IV

Arrays: Array notation and representation, manipulating array elements, using multidimensional arrays, arrays of unknown or varying size, Structures: Purpose and usage of structures, declaring structures, assigning of structures, Pointers to Objects: Pointer and address arithmetic, pointer operations and declarations, using pointers as function arguments, Dynamic memory allocation, defining and using stacks and linked lists.

UNIT-V

Sequential search, Sorting arrays, Strings, Text files, The Standard C Preprocessor: Defining and calling macros, utilizing conditional compilation, passing values to

the compiler, The Standard C Library: Input/Output : fopen, fread, etc, string handling functions, Math functions : log, sin, alike Other Standard C functions.

Text Books:

1. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison- Wesley, 2006.
2. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition [India Edition], 2007.

EC-1862: ELECTRONICS ENGINEERING **L T P**

3 1 0

Unit – I Semiconductor Diodes and Applications:

p-n junction, depletion layer, v-i characteristics, ideal and practical, diode resistance, capacitance, diode ratings (average current, repetitive peak current, peak-inverse voltage), p-n junction as rectifiers (half wave and full wave), filter (Shunt capacitor filter), calculation of ripple factor and load regulation, clippling circuits, clamping circuits, voltage multipliers Breakdown diodes:

Breakdown mechanism (zener and avalanche), kdown characteristics, zener resistance, zener diode ratings, zener diode application as shunt regulator

10 hrs

Unit – II Bipolar Junction Transistor (BJT):

Basic construction, transistor action, CB, CE and CC configurations, input/ output characteristics, biasing of transistors, fixed bias, emitter bias, potential divider bias, comparison of biasing circuits, graphical analysis of CE amplifier, concept of voltage gain, current gain, h-parameter model (low freq), computation of Ai, Av, Ri, Ro of single transistor, CE amplifier configuration **8 hrs**

Unit – III Field Effect Transistor (FET):

JFET: Basic construction, principle of working, concept of pinch-off, maximum drain saturation current, input and transfer characteristics, characteristic equation, CG, CS and CD configurations, fixed and self-biasing of JFET amplifier

MOSFET: depletion and enhancement type MOSFET- construction, operation and characteristics

Operational Amplifier (Op-Amp): concept of ideal operational amplifier, ideal and practical Op-Amp parameters, inverting, non-inverting and unity gain configurations, applications of Op-Amp as adders, difference amplifiers, integrators and differentiator **10 hrs**

Unit – IV Switching Theory and Logic Design (STLD):

Number system, conversion of bases (decimal, binary, octal and hexadecimal numbers) addition and subtraction, fractional numbers, BCD numbers, Boolean algebra, logic gates, concept of universal gates, canonical forms, minimization using K-map (don't care conditions) **7 hrs**

Unit – V Electronics Instruments:

Working principle of digital voltmeter, digital multimeter (block diagram approach), CRO (its working with block diagram), measurement of voltage, current, phase and frequency using CRO **5 hrs**

Text Books:

1. Robert L. Boylestad/ Louis Nashelsky “Electronic Devices and Circuit Theory”, 9th Edition, Pearson Education 2007
2. Devid A. Bell “Electronic Devices and Circuits”, 5th Edition, OXFORD University Press 2008
3. Jacob Millman/ Christos C. Halkias/ Satyabrata Jit “Electronics Devices and Circuits”, 3rd Edition, TMH 2008
4. Morris Mano “Digital Computer Design”, PHI 2003
5. H.S. Kalsi “Electronic Instrumentation”, 2nd Edition, TMH 2007

HU-1849: PROFESSIONAL COMMUNICATION L T P
3 1 0

Unit –I

Basics of Technical Communication

Technical Communication: features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group); Importance of technical communication; Barriers to Communication. **5 hrs**

Unit - II

Constituents of Technical Written Communication

Words and Phrases: Word formation. Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; Requisites of Sentence Construction: Paragraph Development: Techniques and Methods -Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation- various steps. **8 hrs**

Unit - III

Forms of Technical Communication

Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Job application and Resumes. Official Letters: D.O. Letters; Govt. Letters, Letters to Authorities etc. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance. Technical Paper, Project. Dissertation and Thesis Writing: Features, Methods & Writing. **10 hrs**

Unit - IV

Presentation Strategies

Defining Purpose; Audience & Locale; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Space; Setting Nuances of Voice Dynamics; Time- Dimension. **7 hrs**

Unit - V

Value- Based Text Readings

Following essays form the suggested text book with emphasis on Mechanics of writing,

(i) The Aims of Science and the Humanities by M.E. Prior

(ii) The Language of Literature and Science by A.Huxley
(iii) Man and Nature by J.Bronowski
(iv) The Mother of the Sciences by A.J.Bahm
(v) Science and Survival by Barry Commoner
(vi) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
(vii) The Effect of Scientific Temper on Man by Bertrand Russell. **10 hrs**

Text Books:

1. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, New Delhi.
2. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press 2007, New Delhi.

Reference Books:

1. Effective Technical Communication by Barun K. Mitra, Oxford Univ. Press, 2006, New Delhi
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., New Delhi.
3. How to Build Better Vocabulary by M.Rosen Blum, Bloomsbury Pub. London.
4. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors; Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Banerji-Macmillan India Ltd. Delhi.
6. Manual of Practical Communication by L.U.B. Pandey & R.P. Singh; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, Delhi.

ME-1864: MANUFACTURING PROCESSES L T P
2 0 0

Unit-I ***Basic Metals & Alloys:*** Properties and Applications

Properties of Materials: Strength, elasticity, stiffness, malleability, ductility, brittleness, toughness and hardness. Elementary ideas of fracture fatigue & creep. 2

Ferrous Materials: Carbon steels, its classification based on % carbon as low, mild, medium & high carbon steel, its properties & applications. Wrought iron. ***Cast iron. Alloy steels:*** stainless steel, tool steel. Elementary introduction to Heat-treatment of carbon

Steels: annealing, normalizing, quenching & tempering and case-hardening. **3hrs**

Non-Ferrous metals & alloys: Common uses of various non-ferrous metals & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys such as Duralumin. **2 hrs**

Unit-II Introduction to Metal Forming & Casting Process and its applications Metal Forming: Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube- drawing/making and Extrusion, and its products/applications. Press-work, & die & punch assembly, cutting and forming, its applications. Hot-working versus cold- working. **4 hrs**

Casting: Pattern & allowances. Molding sands and its desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace, Die-casting and its uses. **3 hrs**

Unit-III Introduction to Machining & Welding and its applications Machining: Basic principles of Lathe-machine and operations performed on it. Basic description of machines and operations of Shaper-Planer, Drilling, Milling & Grinding. **4 hrs**

Welding: Importance & basic concepts of welding, classification of welding processes. Gas-welding, types of flames. Electric-Arc welding. Resistance welding. Soldering & Brazing and its uses. **3 hrs**

Unit-IV

Misc. Topics Manufacturing: Importance of Materials & Manufacturing towards Technological & Socio- Economic developments. Plant location. Plant layout – its types. Types of Production. Production versus Productivity. **3 hrs**

Non-Metallic Materials: Common types & uses of Wood, Cement-concrete, Ceramics, Rubber, Plastics and composite-materials. **2 hrs**

Misc. Processes: Powder-metallurgy process & its applications, Plastic-products manufacturing, Galvanizing and Electroplating. **2 hrs**

CE-1851: ENVIRONMENT & ECOLOGY

L T P
2 0 0

Unit – I

Definition, Scope & Importance, Need For Public Awareness- Environment definition, Eco system – Balanced ecosystem, Human activities – Food, Shelter, Economic and social Security. **3 hrs**

Effects of human activities on environment-Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment. Sustainable Development. **3 hrs**

UNIT-II

Natural Resources- Water Resources- Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material cycles- C, N and S Cycles. **4 hrs**

Energy – Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources – hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative source of Energy. **4 hrs**

UNIT-III

Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management. **3 hrs**

Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. **3 hrs**

Acid Rain, Ozone Layer depletion, Animal Husbandry. **3 hrs**

UNIT-IV

Environmental Protection- Role of Government, Legal aspects, Initiatives by Non-governmental Organizations, Environmental Education, Women Education. **3 hrs**

Text Books:

1. Environmental Studies – Benny Joseph – Tata McgrawHill-2005
2. Environmental Studies – Dr. D.L. Manjunath, Pearson Education-2006.
3. Environmental studies – R. Rajagopalan – Oxford Publication - 2005.
4. Text book of Environmental Science & Technology – M. Anji Reddy – BS Publication.

Reference Books:

1. Principles of Environmental Science and Engineering – P. Venugoplan Rao, Prentice Hall of India.
2. Environmental Science and Engineering – Meenakshi, Prentice Hall India.

LABORATORY

CY -10867: ENGINEERING CHEMISTRY LAB

L T P
0 0 3

List of Experiments

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in bleaching powder.
5. Determination of iron content in the given water sample by Mohr's methods.
6. PH-metric titration.
7. Determination of Equivalent weight of iron by the chemical displacement method. The equivalent weight of copper is 63.5.
8. Viscosity of an addition polymer like polyester by Viscometer.
9. Determination of iron concentration in sample of water by colorimetric method. The method involves the use of KSCN as a color developing agent and the measurements are carried out at λ max 480NM.
10. Element detection and functional group identification in organic compounds.
11. Preparation of Bakelite resin.

ME-10854: ENGINEERING MECHANICS LAB

L T P
0 0 2

Note- (Any ten experiments from the above list or institute may suitably design experiments)

List of Experiments

1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen.
2. To determine the compression test and determine the ultimate compressive strength for a specimen
3. To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the toughness.
4. To determine the hardness of the given specimen using Vickers/Brinell/Rockwell hardness testing machine.
5. To study the slider-crank mechanism etc. of 2-stroke & 4-stroke I.C. Engine models.
6. Friction experiment(s) on inclined plane and/or on screw-jack.
7. Simple & compound gear-train experiment.
8. Worm & worm-wheel experiment for load lifting.
9. Belt-Pulley experiment.
10. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
11. Torsion of rod/wire experiment.
12. Experiment on Trusses.
13. Statics experiment on equilibrium
14. Dynamics experiment on momentum conservation
15. Dynamics experiment on collision for determining coefficient of restitution
16. Experiment on Moment of Inertia.

EE-10869: ELECTRICAL ENGINEERING LABORATORY

L T P

0 0 3

Note: A minimum of Ten experiments from the following should be performed

List of Experiments

1. Verification of Kirchhoff's laws
2. Verification of (i) Superposition theorem (ii) The venin's Theorem (iii) Maximum Power Transfer Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Measurement of power in 3- phases circuit by two wattmeter method and determination of its power factor.
6. Determination of parameters of ac single phase series RLC circuit
7. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
8. To study speed control of dc shunt motor using (i) armature voltage control (ii) field flux control.
9. Determination of efficiency of a dc shunt motor by load test
10. To study running and speed reversal of a three phase induction motor and record speed in both directions.
11. To measure energy by a single phase energy meter and determine error.
12. To study P-N diode characteristics
13. To study full wave and half wave rectifier circuits with and without capacitor and determine ripple factors.
14. To study various logic gates (TTL)
15. To study Operational Amplifier as Adder and Sub tractor
16. To study transistor as a switch.

CS-10856: COMPUTER PROGRAMMING LAB L T P

0 0 3

Suggested Assignments to be conducted on a 3-hour slot. It will be conducted in tandem with the theory course so the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course should be appropriately be sequenced for synchronization with the laboratory. A sample sequence of topics and lab classes for the topic are given below:

1. Familiarization of a computer and the environment and execution of programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structure
9. Linked lists
10. Data structures

Week	Lecture 1	Lecture 2	Lecture 3	Lab Meeting
Week-1	Introduction to any OS, Programming Environment	A Simple C program	Need of Data structures & Algorithms	Get familiar with OS and Environment.
Week-2	An Example, Termination, Correctness	Different Types of Programming Languages	Number Systems	Get familiar with C compiler Implement and Test Small Routine in C
Week-3	Number Systems	Standard I/O in C	Data Types and Variables	Implement and Test Small Routine in C
Week-4	Data Types and Variable	Data Types and Variable	Operators & Expression	Evaluation of Expression
Week-5	Operators & Expression	Operators & Expression	Operators & Expression	Evaluation of Expression
Week-6	IF, SWITCH Statements	IF, SWITCH Statements	Nested If Statement	Iteration
Week-7	Repetition structure in C	Repetition structure in C	Modular Programming	Iteration, Function
Week-8	Modular Programming	Modular Programming	Arrays	Recursion, Function
Week-9	Arrays	Structures	Structures	Arrays, Structures
Week-10	Pointers	Pointers	Pointers	Linked Lists
Week-11	Searching	Selection	Sorting	Searching, Selection
Week-12	Sorting	Strings	Strings	Sorting, Strings
Week-13	Files	Files	Std C Preprocessor	Files
Week-14	Std C Library	Std C Library	Std C Library	Use of Std. C Library

It is suggested that some problems related to continuous domain problems in engineering and their numerical solutions are given as laboratory assignments. It may be noted that some of basic numerical methods are taught in the Mathematics course.

WS-10871: WORKSHOP PRACTICE **L T P**
0 0 2

1. **Carpentry Shop:**
   - Study of tools & operations and carpentry joints.
   - Simple exercise using jack plane.
   - To prepare half-lap corner joint, mortise & tendon joints.
   - Simple exercise on woodworking lathe.
2. **Fitting Bench Working Shop:**
   - Study of tools & operations
   - Simple exercises involving fitting work.
   - Make perfect male-female joint.
   - Simple exercises involving drilling/tapping/dieing.
3. **Black Smithy Shop:**
   Study of tools & operations
- Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.

4. **Welding Shop:**
- Study of tools & operations of Gas welding & Arc welding
- Simple butt and Lap welded joints.
- Oxy-acetylene flame cutting.

5. **Sheet-metal Shop:**
- Study of tools & operations.
- Making Funnel complete with ‘soldering’.
- Fabrication of tool-box, tray, electric panel box etc.

6. **Machine Shop:**
   Study of machine tools and operations.
- Plane turning.
- Step turning
- Taper turning.
- Threading
- Single point cutting tool grinding.

7. **Foundry Shop:**
   Study of tools & operations
- Pattern making.
- Mould making with the use of a core.
- Casting

CE-10872: COMPUTER AIDED ENGINEERING GRAPHICS

L T P
0 1 3

1. Introduction to Computer Aided Sketching

Introduction, Drawing Instruments and their uses, BIS conventions, lettering Dimensioning and free hand practicing.

Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Coordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line convention, material conventions and lettering. **2-Sheet**

2. Orthographic Projections **2-Sheet**

Introduction, Definitions- Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems).

3. Orthographic Projections of Plane Surfaces

(First Angle Projection Only) Introduction, Definitions-projections of plane surfaces-triangle, square rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only (No problems on punched plates and composite plates.) **1-Sheet**

4. Projections of Solids (First Angle Projection Only) **2-Sheet**

Introduction, Definitions- Projections of right regular- tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions. (No problems on octahedrons and combination solid)

5. Sections and Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, section views, Sectional views, apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. (No problems on section of solids) **1- Sheet**

Development of lateral surface of above solids, their frustums and truncations. (No problems on lateral surfaces of trays, Tetrahedrons spheres and transition pieces).

6. Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric Projection of simple plane figures, Isometric Projection of tetrahedron, hexahedron (cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of three Solids). **1-Sheet**

Note: At least 3 drawing assignments must be on AUTOCAD.

Text Books:

1. Engineering Drawing – N.D. Bhatt & V.M. Panchal, 48th edition, 2005 Charotar Publishing House, Gujarat.
2. A Primer on Computer Aided Engineering Drawing-2006, Published by VTU, Belgaum.

Reference Book:

1. Computer Aided Engineering Drawing – S. Trymbaka Murthy, - I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition-2006.
2. Engineering Graphics – K.R. Gopalakrishna, 32nd edition, 2005 – Subash Publishers Bangalore.
3. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production – Luzadder Warren J., duff John M., Eastern Economy Edition, 2005 – Prentice- Hall of India Pvt. Ltd., New Delhi.

PH-10873: PHYSICS LAB L T P
0 0 2

Any ten experiments, at least four from each group.

List of Experiments

Group –A

1. To determine the wavelength of monochromatic light by Newton's ring.
2. To determine the wavelength of monochromatic light with the help of Fresnel's bi prism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.
4. To determine the specific rotation of cane sugar solution using polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To study the polarization of light by simple reflection using laser.
7. Measurement of Wavelength of a laser (He- Ne) light using single slit diffraction.

Group – B

1. To determine the specific resistance of a given wire using Carey Foster's bridge.
2. To study the variation of magnetic field along the axis of current carrying Circular coil and then to estimate the radius of the coil.
3. To verify Stefan's Law by electrical method.
4. To calibrate the given ammeter and voltmeter by potentiometer.
5. To study the Hall Effect and determine Hall coefficient, carrier density and - mobility of a given semiconductor using Hall Effect set up.
6. To determine the energy band gap of a given semiconductor material.
7. To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
8. To draw hysteresis curve of a given sample of ferromagnetic material and from - this to determine magnetic susceptibility and permeability of the given specimen.
9. To determine the ballistic constant of a ballistic galvanometer.
10. To determine the coefficient of viscosity of a liquid.
11. Measurement of fiber attenuation and aperture of fiber.
12. High resistance by leakage method.
13. Magnetic Susceptibility of paramagnetic solution.

HU-1863: PROFESSIONL COMMUNICATION LABORATORY

L T P
0 0 2

Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (I.P.A.)

LIST OF PRACTICALS

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic's/Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.
6. Theme- Presentation/ Key-Note Presentation based on correct argumentation methodologies.
7. Individual Speech Delivery/Conferences with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehension Skills based on Reading and Listening Practicals on a model Audio- Visual Usage.

Reference Books:

1. Bansal R.K. & Harrison: Phonetics in English, Orient Longman, New Delhi.
2. Sethi & Dhamija: A Course in Phonetics and Spoken English, Prentice Hall, New Delhi.
3. L.U.B.Pandey & R.P.Singh, A Manual of Practical Communication, A.I.T.B.S. Pub. India Ltd. Krishan Nagar, Delhi.
4. Joans Daniel, English Pronouncing Dictionary, Cambridge Univ. Press

MA-1855: MATHEMATICS –II

L T P
3 1 0

Unit - I

Differential Equations: Linear differential equations of nth order with constant coefficients, Complementary functions and particular integrals, Simultaneous linear differential equations, Solution of second order differential equation by changing dependent and independent variables, Method of variation of parameters, Applications to engineering problems (without derivation).

Unit – II

Series Solution and Special Functions: Series solution of ordinary differential equations of 2nd order with variable coefficients (Frobenius Method), Bessel and Legendre equations and their series solutions, Properties of Bessel functions and Legendre polynomials.

Unit – III

Laplace Transform: Laplace transform, Existence theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function, Dirac delta function, Laplace transform of periodic functions, Convolution theorem, Application to solve simple linear and simultaneous differential equations.

Unit – IV

Fourier Series and Partial Differential Equations: Periodic functions, Trigonometric series, Fourier series of period 2π , Euler's formulae, Functions having arbitrary period, Change of interval, Even and odd functions, Half range sine and cosine series, Harmonic analysis.

Solution of first order Lagrange's linear partial differential equations, Linear partial differential equations with constant coefficients of 2nd order and their classifications - parabolic, elliptic and hyperbolic with illustrative examples.

Unit – V:

Applications of Partial Differential Equations: Method of separation of variables for solving partial differential equations, Wave equation up to two-dimensions, Laplace equation in two-dimensions, Heat conduction equations up to two-dimensions, Equations of transmission lines.

Test Books:

1. B.V.Ramana, Higher Engineering Mathematics, Tata Mc-Graw-Hill Publishing Company Ltd., 2008.
2. R.K.Jain & S.R.K.Iyenger, Advance Engineering Mathematics, Narosa Publishing House, 2002.

Reference Books:

1. B.S.Grewal, Engineering Mathematics, Khanna Publishers, 2004.

2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.

3. E.Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.

4. C.Ray Wylie & Louis C. Barrett, Advanced Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd. 2003

5. Peter V. O'Neil, Advanced Engineering Mathematics, Thomson (Cengage) Learning, 2007.

6. G.F.Simmons, Differential Euations, Tata Mc Graw-Hill Publishing Company Ltd. 1981.

7. Chandrika Prasad Advanced Mathematic for Engineers, Prasad Mudranalaya, 1996.

PH-1857: ENGINEERING PHYSICS- II

L T P
2 1 0

Unit – I **10 Hrs.**

Wave Mechanics and X-ray Diffraction: Wave- particle duality, de-Broglie matter waves, Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Wave function and its significance, Schrödinger's wave equation – particle in one dimensional box.
Diffraction of X-rays by crystal planes, Bragg's spectrometer, Compton's effect.

Unit – II **08 Hrs.**

Dielectric and Magnetic Properties of Materials: Dielectric constant and Polarization of dielectric materials, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One- Dimensional), Claussius Mussoti-Equation, Ferro and Piezo electricity (Qualitative), Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Langevin's theory for dia and paramagnetic material, Phenomena of hysteresis and its applications.
Ultrasonic: Generation, detection and application of ultrasonics

Unit-III **06 Hrs.**

Electromagnetics: Displacement Current, Maxwell's Equations (Integral and Differential Forms). Equation of continuity, EM- Wave equation and its propagation characteristics in free space and in conducting media, Poynting theorem and Poynting vectors.

Unit-IV **06 Hrs.**

Superconductivity and Science and Technology of Nanomaterials: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, Temperature dependence of critical field, BCS theory (Qualitative), High temperature superconductors. Characteristics of superconductors in superconducting state, Applications of Super-conductors.
Introduction to Nanomaterials- Basic principle of nanoscience and technology, creation and use of buckyballs, structure, properties and uses of Carbon nanotubes, Applications of nanotechnology.

Reference books:

1. Concept of Modern Physics - - Beiser (Tata Mc-Graw Hill)
2. Solid State Physics - C. Kittel, 7th edition (Wiley Eastern) Materials Science and Engineering - V. Raghavan (Prentice- Hall India)
3. Solid State Physics - - S.O. Pillai, 5th edition (New Age International)
4. Nanotechnolog - Rechard Booker & Earl Boysen (Wiley Pub)

DEPARTMENT OF MECHANICAL ENGGINEERING

SYLLABUS

For 2nd, 3rd and 4th Year

[2431]: MATHEMATICS –III **L T P: 3 0 0**

Unit – I: Function of Complex variable

Analytic function, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals of the type **10**

Unit – II: Statistical Techniques - I

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non –linear and multiple regression analysis, Probability theory. **8**

Unit – III: Statistical Techniques - II

Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tests of significations: Chi-square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc. Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, , R, p, np, and c charts. **8**

Unit – IV: Numerical Techniques – I

Zeroes of transcendental and polynomial equation using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals. **8**

Unit – V: Numerical Techniques –II

Solution of system of linear equations, Gauss- Seidal method, Crout method. Numerical differentiation, Numerical integration, Trapezoidal, Simpson's one third and three-eight rules, Solution of ordinary differential (first order, second order and simultaneous) equations by Euler's, Picard's and forth-order Runge- Kutta mehthods **8**

Test Books: -

1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi, 2003.
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.,2000

Reference Books: -

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House,2002.
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
5. Devi Prasad, An introduction to Numerical Analysis, Narosa Publication house, New Delhi2006.
6. T. Veerajan & T. Ramchandrandran, Theory & Problems in Numerical Methods, TMH, New Delhi, 2004.
7. S.P.Gupta, Statistical Methods, Sultan and Sons, New Delhi, 2004.
8. Devore, Probability and Statistics, Thomson (Cengage) Learning, 2007.
9. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, 2003.

[2432] MATERIAL SCIENCE **L T P: 3 0 0**

Unit-I

Introduction: Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding **4**

Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. Xray crystallography techniques. Imperfections, Defects & Dislocations in solids **3**

Unit-II

Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress vs strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testings such as Strength testings, Hardness testing, Impact testing, Fatigue testing Creep testing, Non-destructive testing (NDT) **4**

Microstructural Exam: Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass **2**

Phase Diagram and Equilibrium Diagram: Uniary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram. **4**

Unit-III

Ferrous materials: Brief introduction of iron and steel making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses. **3**

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams. **2**

Non-Ferrous metals and alloys: Non-ferrrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminium alloys such as Duralumin. Other advanced materials/alloys. **3**

Unit-IV

Magnetic properties: Concept of magnetism - Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages. **2**

Electric properties: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors. Basic devices and its application. Diffusion of Solid. **3**

Super conductivity and its applications. Messier effect. Type I & II superconductors. High Tc superconductors. **2**

Unit-V

Ceramics: Structure types and properties and applications of ceramics. Mechanical/Electrical behaviour and processing of Ceramics **2**

Plastics: Various types of polymers/plastics and its applications. Mechanical behaviour and processing of plastics. Future of plastics. **2**

Other materials: Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses. Brief introduction to Smart materials & Nano-materials and their potential applications **3**

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control. **2**

References:

1. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesley Publication.
2. K.M.Gupta, Materials Science, Umesh Publication.
3. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.
4. V. Raghvan - Material Science, Prentice Hall.
5. Narula - Material Science, TMH.
6. Srivastava, Srinivasan - Science of Materials Engineering, NewAge Publication.

[2433]: APPLIED THERMODYNAMICS **L T P: 3 0 0**

Unit- I

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature and its' measurement, Temperature scales **1**

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, first law of thermodynamics, Internal energy and enthalpy, first law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (Non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I**.** **4**

Second law: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II. **4**

Entropy: Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics. **4**

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function. **3**

Unit – II

Properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle. **5**

Introduction to working of IC engines: Compression Ignition engines, Spark Ignition engines, 2 stroke and 4 stroke engines, Performance parameters of IC engine, Heat balance sheet. **2**

Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic & Isothermal compressibility. **3**

Fuels and Combustion: Combustion analysis, Heating Values, Air requirement, Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature. **4**

Unit-III

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, Draught & its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. **6**

Condenser: Classification of condenser, Air leakage, Condenser performance parameters **2**

Unit-IV

Steam Engines: Rankine and modified Rankine cycles, Working of stream engine, Classification of steam engines, Indicator diagram, Saturation curve, Missing quantity, Heat balance. **3**

Steam& Gas Nozzles: Flow through nozzle, Variation of velocity, Area and specific volume, choked flow, Throat area, Nozzle efficiency, Off design operation of nozzle, **4**

Effect of friction on nozzle, Super saturated flow.

Unit-V

Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. **3**

Steam Turbines: Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, Impulse reaction Turbines, state point locus, Comparison with steam engines, Losses in steam turbines, Governing of turbines. **4**

Unit-VI

Gas Turbine: Gas turbine classification Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. **4**

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine. **3**

Books:

1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of Thermodynamics by Sonntag, Wiley India Pvt. Ltd.
3. Fundamentals of Classical Thermodynamics by Van Wylen, John wiley & sons.
4. Thermodynamics by J.P. Holman, McGraw Hill.
5. Engineering Thermodynamics by P.K.Nag, Tata Mc Graw Hill Pub.
6. Engineering Thermodynamics by Onkar Singh, New Age International Pub..
7. Thermal Engineering By R.K. Rajput, Laxmi Publication.
8. Engineering Thermodynamics by C.P. Arora.
9. Applied thermodynamics by Onkar Singh, New Age International (P) Publishers Ltd.
10. Basic and Applied Thermodynamics by P.K. Nag, Tata Mc Graw Hill Pub.
11. Thermal Engg. By P.L. Ballaney, Khanna Publisher
12. Theory of Stream Turbine by W.J. Kearton
13. Steam & Gas Turbine by R.Yadav, CPH Allahabad
14. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
15. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man

[2434]: STRENGHT OF MATERIAL **L T P: 3 1 0**

UNIT-I

Compound stress and strains: Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. **3**

3-D Stress, Theory of failure, Castinglion's Theorem, Impact load: Three-dimensional state of stress & strain, equilibrium equations. Generalized Hook's Law. Theories of Failure. Castigliano's Theorem. Impact load & stresses. **5**

UNIT –II

Stresses in Beams: Review of pure Bending. Direct and shear stresses in beams due to transverse and axial loads, composite beams. **2**

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams. **4**

Torsion: Review of Torsion, combined bending & torsion of solid & hollow shafts. **2**

UNIT-III

Helical and Leaf Springs: deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs. **4**

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Ranking Gardon Formulae, Examples of columns in mechanical equipments and machines. **4**

UNIT-IV

Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain. **2**

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders. Stresses in rotating shaft and cylinders. Stresses due to interference fits. **6**

UNIT-V

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression. **4**

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section. **4**

Books:

1. Mechanics of Materials by Pytel
2. Strength of Materials by Ryder
3. Strength of Materials by Timoshenko and & Yσungs
4. Mechanics of Materials by Bear Jhonson

[2435]: FLUID MECHANICS **L T P: 3 0 0**

Unit-I

Introduction:

Fluid and continuum, Physical properties of fluids, Rheology of fluids

Unit-II

Kinematics of Fluid flow: Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three-dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body.

Unit-III

Fluid Statics: Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

Unit-IV

Dynamics of Fluid Flow: Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, hot-wire anemometer and LDA, notches and weirs, momentum equation and its application to pipe bends.

Unit-V

Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.

Unit-VI

Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.

Unit-VII

Boundary Layer Analysis: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect.

References:

1. S Narasimhan: First Course in Fluid Mechanics , University Press
2. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
3. M M Das : Fluid Mechanics & Turbomachines , Oxford University Press
4. S.K.Agarwal : Fluid Mechanics & Machinery, TMH
5. Garde, R.J., " Fluid Mechanics through Problems", New Age International Pvt. Ltd, New Delhi, 2nd Edition.
6. Hunter Rouse, "Elementary Mechanics of Fluids", John Wiley & Sons. Omc. 1946
7. I.H.Shames, "Mechanics of Fluids", McGraw Hill, Int. Student, Education, 1988.
8. Fluid Mechanics by Jagdish Lal
9. Vijay Gupta and S.K.Gupta, " Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.
10. Modi, P.N., and Seth, S.H., "Hydrualics and Fluid Machines", Standard Book House, 1989.

[20436]: MATERIAL SCIENCE AND TESTING LAB L T P: 0 0 2

(A). Material Science Lab Experiments: (at least 5 of the following)

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain Size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Faradays law of electrolysis experiment.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro & Micro Examination.
10. Suitable experiment on Magnetic/ Electrical/Electronic materials.

(B). Material Testing Lab Experiments: (at least 5 of the following)

1. Strength testing of a given mild steel specimen on UTM with full details and s-e plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact testing on impact testing machine like Charpy, Izod or both.
4. Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index testing on spring testing machine.
6. Fatigue testing on fatigue testing machine.
7. Creep testing on creep testing machine.
8. Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion testing of a rod on torsion testing machine.
10. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

[20437]: APPLIED THERMODYNAMICS LAB **L T P: 0 0 2**

Minimum 10 experiments out of following;

1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study and working of Two stroke petrol Engine
4. Study and working of Four stroke petrol Engine
5. Determination of Indicated H.P. of I.C. Engine by Morse Test
6. Prepare the heat balance for Diesel Engine test rig
7. Prepare the heat balance sheet for Petrol Engine test rig
8. Study and working of two stroke Diesel Engine
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine
11. Study of Pressure compounded steam turbine
12. Study of Impulse & Reaction turbine
13. Study of steam Engine model.
14. Study of Gas Turbine Model
15. Any other suitable experiment on thermodynamics

[20438]: FLUID MECHANICS LAB **L T P: 0 0 2**

1. To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also, to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter, venturi meter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
5. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
6. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
7. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

[20439]: MACHINE DRAWING – I LAB **L T P: 0 0 2**

Introduction (1 drawing sheet): Graphics Language, Classification of drawings, Principles of drawing, IS codes for machine drawing, scales, types of lines, section lines, Dimensioning **2**

Orthographic Projections (1 drawing sheet): Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views **2**

Screwed fasteners (2 drawing sheet): Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangement of nuts **2**

Keys and Cotters and Pin joint (1 drawing sheet): Types of keys, Cotter joint or Knuckle joint **2**

Shaft Couplings (1 drawing sheet): Introduction, Rigid coupling or Flexible coupling **2**

Riveted joints (1 drawing sheet): Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint **1**

Assembly Drawing (1 drawing sheet): Introduction, Engine parts-stuffing box, cross head **1**

Free hand sketching*: Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

* students may be asked to submit the free hand sketching assignment at the end of the semester

Books and References:

1. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy-New Age
2. Machine Drawing-PS Gill-SK Kataria & sons
3. Machine Drawing-N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
4. Engineering drawing Practice for School and Colleges, SP46-1988 (BIS)

[2437]: KINEMATICS OF MACHINES **L T P: 3 1 0**

UNIT I

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain **6**

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism **3**

UNIT II

Acceleration in Mechanisms: Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism **4**

Mechanisms with Lower Pairs: Pantograph, Exact straight-line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight-line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms. **5**

UNIT III

Kinematics Synthesis of Planar Linkages: Movability of four bar linkages, Grashoff"s low, Grafical methods of synthesisand Three position synthesis of four bar and slider crank mechanisms, Analytical method- Freudensten"s equation for function generation (Three position) **7**

UNIT IV

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower **7**

UNIT V

Gears: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear. **7**

Books and References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines-S.S. Rattan
6. Kinematics of Machines-Dr. Sadhu singh
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

[2438] : MANUFACTURING SCIENCE- I **L T P: 3 0 0**

Unit-I

Introduction: Importance of manufacturing. Economic & technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items **2**

Metal Forming Processes: Elastic & plastic deformation, yield criteria. Hot working vs cold working. Analysis (equilibrium equation method) of Forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging **7**

Unit-II

Metal Forming Processes (continued): Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application **3**

Condition for Rolling force and power in rolling. Rolling mills & rolled-sections **2**

Design, lubrication and defects in metal forming processes **2**

Unit-III

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking vs Piercing. Compound vs Progressive die. Flat-face vs Inclined-face punch and Load(capacity) needed. **4**

Analysis of forming process like cup/deep drawing. Bending & spring-back. **3**

Unit-IV

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming. **2**

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications. **2**

Jigs & Fixtures: Locating & Clamping devices & principles. Jigs and Fixtures and its applications. **2**

Manufacturing of Plastic components: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives. **2**

Unit-V

Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, Riser, Runners, Core. Solidification of casting, Sand casting, defects & remedies and inspection. Cupola furnace. **7**

Die Casting, Centrifugal casting. Investment casting, CO_2 casting and Stir casting etc. **3**

Books:

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by P.C. Pandey
3. Production Technology by R.K. Jain
4. Manufacturing Technology by P.N. Rao., TMH
5. Materials and Manufacturing by Paul Degarmo.
6. Manufacturing Science by KM Moeed.
7. Manufacturing Engineering & Technology by Kalpakjian, Pearson Pub.

[2439]: MEASUREMENT METROLOGY AND CONTROL L T P: 3 0 0

Unit-I: Mechanical Measurements

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors.	**4**
Sensors and Transducers: Types of sensors, types of transducers and their characteristics.	**2**
Signal transmission and processing: Devices and systems. Signal Display & Recording Devices	**3**

Unit-II

Time related measurements: Counters, stroboscope, frequency measurement by direct comparison.	**1**
Measurement of displacement	**1**
Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures.	**1**
Strain measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.	**2**
Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems.	**1**
Temperature measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers.	**2**
Vibration: Seismic instruments, vibration pickups and decibel meters, vibrometers accelerometers	**2**

Unit-III:

Metrology and Inspection: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardisation.	**2**
Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator.	**2**
Limit gauges classification, Taylor's Principle of Gauge Design.	**1**

Unit-IV

Measurement and Inspection: Dimensional inspection – Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection ,Measurement of geometric forms like straightness, flatness, roundness.	**2**
Tool makers microscope, profile project autocollimator.	**1**
Interferometry: principle and use of interferometry, optical flat.	**2**
Measurement of screw threads and gears.	**1**
Surface texture: quantitative evaluation of surface roughness and its measurement.	**1**

References:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963
5. Gupta, I.C., "Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, "Mechanical Measurement" New Age Publishers
7. Jain, R.K., "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers

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[20441]: MANUFACTURING SCIENCE-I LAB **L T P: 0 0 2**

Experiments:

Say minimum 8 experiments out of following (or such experiment).

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testings (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

[20442]: MEASUREMENT & METROLOGY LAB **L T P: 0 0 2**

Experiments: Minimum 8 out of following (or such experiments)

1. Study & working of simple measuring instruments- Vernier caliper's, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sine bar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & tolerances
9. Study of Pressure & Temperature measuring equipment.
12. Strain gauge measurement.
13. Speed measurement using stroboscope.
14. Flow measurement experiment
15. Vibration/work measuring experiment.
16. Experiment on Dynamometers.

[20443] MACHINE DRAWING – II LAB **L T P: 0 0 2**

Review of Orthographic Projections (1 drawing sheet): Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views	**2**
Part and Assembly Drawing (2 drawing sheet): Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc	**2**
Specification of Materials (1 drawing sheet): Engineering materials, representation, Code designation of steel, copper, aluminium etc.	**1**
Limits, Tolerance and Fits (1 drawing sheet): Limit system, Tolerances, Method of placing limit dimensions, Fits-types	**2**
Surface Roughness (1 drawing sheet): Introduction, nomenclature, machining symbols, indication of surface roughness	**1**
Production Drawing (1drawing sheet): Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc.	**2**
Computer Aided Drafting (2 drawings): Introduction, input, output devices, introduction to software like AutoCAD, ProE, basic commands and development of 2D and 3D drawings of simple parts	**3**

Books and References:

1. Machine Drawing - KL Narayana, P Kannaiah, KV Reddy - New Age
2. Machine Drawing - PS Gill - SK Kataria & sons
3. Machine Drawing -N. Siddeshswar, P Kannaiah, VVS Shastry -Tata McGraw Hill
4. Engineering Drawing - RK Dhawan - S. Chand
5. AutoCAD-S. Vshal - Dhanpat Rai
6. Engineering Graphics - BK Goel & PK Goel - SK Kataria
7. Computer Aided Engineering Graphics - Rajashekhar Patil - New Age
8. Engineering Drawing - Dhananjay A Jolhe - Tata McGraw Hill
9. Engineering Drawing - CM Agrawal - Tata McGraw Hill
10. Machine Drawing – Ajeet Singh – The Mc Graw Hill Companies

[20444] : ELECTRICAL MACHINES LAB **L T P: 0 0 2**

Minimum 8 out of following Experiments

1. To obtain speed-torque characteristics and efficiency of a dc shunt motor by direct loading.
2. To obtain efficiency of a dc shunt machine by no load test.
3. To obtain speed control of dc shunt motor using (a) armature voltage control (b) field control.
4. To determine polarity and voltage ratio of single phase and three phase transformers.
5. To obtain efficiency and voltage regulation by performing O.C. and S.C. tests on a single phase transformer at full load and 0.8 p.f. loading.
6. To obtain 3-phase to 2-phase conversion using Scott connection.
7. To perform load test on a 3-phase induction motor and determine
   (a) speed- torque characteristics
   (b) power factor v/s line current characteristics.
8. To study speed control of a 3-phase induction motor using
   (a) Voltage Control
   (b) Constant (Voltage/ frequency) control.
9. To perform open circuit and short circuit test on a 3-phase synchronous machine and determine voltage regulation at full load and unity, 0.8 lagging and 0.8 leading power factor using synchronous impedance method.
10. To determine V-curve of a 3-phase synchronous motor at no load, half load and full load

[3432]: MACHINE DESIGN – I **L T P: 3 0 0**

UNIT I

Introduction: Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads **3**

Design against Static Load Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure **4**

UNIT II

Design against Fluctuating Loads Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria **4**

Riveted Joints-Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint **4**

UNIT III

Shafts: Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity **4**

Keys and Couplings Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings Design of rigid and flexible couplings **4**

UNIT IV

Mechanical Springs: Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading **4**

Power Screws: Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack **3**

Books and References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill

Note: Design data book is allowed in the examination

[3433]: DYNAMICS OF MACHINE **L T P: 3 0 0**

UNIT I

Static & Dynamic Force Analysis: Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis-Piston and crank effort **5**

UNIT II

Balancing of Machines: Static and dynamic balancing, Balancing of several masses in the same plane and different planes, Balancing of reciprocating masses, Balancing of primary force in reciprocating engine, Partial balancing of two-cylinder locomotives, Variation of tractive force, swaying couple, hammer blow **7**

UNIT- III

Friction: Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive **6**

Brakes & Dynamometers (Mechanical Type): Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers **3**

UNIT III

Governors: Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, Controlling force diagrams for Porter governor and Spring controlled governors **8**

UNIT IV

Gyroscopic Motion: Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles **3**

Mechanical Vibrations: Types of vibrations, Degrees of freedom, Single degree free & damped vibrations, Forced vibration of single degree system under harmonic excitation, Critical speeds of shaft **4**

Books and References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines-S.S. Rattan
6. Kinematics of Machines-Dr. Sadhu singh
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

[3434]: MANUFACTURING SCIENCE-II **L T P: 3 0 0**

Unit-I

Metal Cutting and Machine Tools: Metal Cutting Mechanics of metal cutting. Geometry of tool and nomenclature. ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting **9**

Unit-II

Machine Tools: Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout. **2**

Shaper, slotter, planer: Construction, operations & drives. **1**

Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. **2**

Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills. **2**

Unit-III

Grinding & Super finishing

Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. **4**

Super finishing: Honing, lapping, polishing. **1**

Standardization & Interchangeability, Limits, Fits & Tolerance and Surface roughness: Introduction to Standardization & Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. **3**

Unit-IV

Metal Joining (Welding): Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing **8**

Thermodynamic and Metallurgical aspects in welding and weld, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. **2**

Unit-V

Introduction to Un-conventional Machining and Welding

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. **6**

Books

1. Manufacturing science by Ghosh and Mallik
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey
6. Modern Machining Processes by P.C. Pandey & H.S. Shan
7. Manufacturing science by Degarmo
8. Fundamentals of metal cutting & machine tools - Juneja & Shekhon
9. Process & materials of manufacturing - Lindburg.
10. Advanced Machining Process - VK Jain

[3435]: HEAT AND MASS TRANSFER **L T P: 3 1 0**

UNIT-I

Introduction to Heat Transfer: Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. **2**

Conduction: One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. **3**

Steady State one-dimensional Heat conduction: Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. **3**

UNIT-II

Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. **3**

Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts **4**

UNIT-III

Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. **4**

Natural Convection: Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection. **3**

UNIT-IV

Thermal Radiation: Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non-black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Greenhouse effect. **8**

UNIT-5

Heat Exchanger: Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. **3**

Condensation and Boiling: Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. **3**

Introduction to Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film. **2**

Books:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer by J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John

Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

Note: Data book is allowed in the examination

[30436]: MACHINE DESIGN – I LAB **L T P: 0 0 2**

Note: Eight experiments out of the following are to be performed. Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack

[30437]: DYNAMICS OF MACHINE LAB **L T P: 0 0 2**

Note: Eight experiments out of the following are to be conducted

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

[30438]: MANUFACTURING SCIENCE-II LAB **L T P: 0 0 2**

min 8 experiments out of the following

(or such experiment along-with study of the machines/processes)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints, HAZ.

[30439]: HEAT & MASS TRANSFER – LAB **L T P: 0 1 2**

Minimum 10 experiment of the following

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

[3436]: OPERATONS RESEARCH **L T P: 3 1 0**

Unit-I

Introduction: Linear Programming Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem sensitivity analysis.

Unit-II

Transportation & Assignment problems Deterministic Dynamic Programming Multistage decision problems & solution, Principle of optimality.

Unit-III

Decision theory: Decision under various conditions

Game Theory: Two Person Zero sum game, Solution with / without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Liner Programming

Sequencing Basic assumption, n Jobs through two / three machines, Jobs on m machines

Unit-IV

Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy

Unit-V

Simulations: Use, advantages& limitations, Monte-carlo simulation, Application to queuing, inventory & other problems

Queuing models: Characteristics of Queuing Model, M/M/1 & M/M/S system, cost consideration

Text Books

Operations Research by: Wangner

Operations Research by: Taha

Introduction to Management Science by: Hiller & Hiller

Operations Research by: Wayne L. Winston

[3437]: I C ENGINES **L T P: 3 0 0**

Unit-I

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Stirling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine **5**

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. **3**

Testing and Performance: Performance parameters, Basic measurements, blow by measurement, Testing of SI and CI engines. **2**

Unit–II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. **2**

Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. **3**

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition. **2**

Unit–III

CI Engine: Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines. **2**

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. **3**

Scavenging in 2 Stroke engines, pollution and it's control. **2**

Unit-IV

Engine Cooling: Different cooling systems, Radiators and cooling fans. **1**

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. **2**

Supercharging: Effect of altitude on power output, Types of supercharging **1**

Unit-V

Compressors: Classification, Reciprocating compressors, Single and Multi-stage compressors, Intercooling, Volumetric efficiency. **2**

Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor. **2**

Books:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO
2. IC Engines, by Rogowsky, International Book Co.
3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata Mc Graw Hill Pub.

[3438]: MACHINE DESIGN-II **L T P: 3 0 0**

UNIT I

Spur Gears: Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **5**

UNIT II

Helical Gears: Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears. **3**

UNIT III

Worm Gears: Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing **3**

UNIT IV

Sliding Contact Bearing: Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing, **5**

Rolling Contact Bearing: Advantages and disadvantages, Types of ball bearing, thrust ball bearing, types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing **6**

UNIT V

IC Engine Parts: Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft **6**

Books and References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

[3439]: FLUID MACHINARY **L T P: 3 0 0**

UNIT-I

Introduction: Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation **4**

Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Effect of inclination of jet with the surface. **2**

Hydraulic Turbines:

Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. **2**

UNIT-II

Reaction Turbines: Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines **8**

UNIT-III

Centrifugal Pumps: Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics. **7**

UNIT-IV

Positive Displacement Pumps: Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics. **6**

UNIT-V

Other Machines: Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics. **5**

Water Lifting Devices: Hydraulic ram, Jet pumps, Air lift pumps.

Books:

Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
Applied Hydraulics by Addison
Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
Hydraulic Machines by D S Kumar

[3440]: REFRIGERATION & AIR CONDITIONING **L T P: 3 0 0**

Unit-I

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART). **8**

Unit-II

Vapour Compression System: Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage System, Cascade system. **8**

Unit-III

Vapour Absorption system: Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium Bromide water vapour absorption system, Comparison **5**

Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. **3**

Unit-IV

Air Conditioning: Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). **8**

Unit-V

Refrigeration Equipment & Application: Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning. **7**

Books:

1. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
2. Refrigeration and Air conditioning by C.P Arora.
3. Refrigeration and Air conditioning by Arora & Domkundwar.
4. Refrigeration and Air conditioning by stoecker & Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Refrigeration and Air conditioning by P.L. Baloney.
7. Thermal Environment Engg. By Kuhen, Ramsey & Thelked.

[30441]: MACHINE DESIGN-II – LAB **L T P: 0 0 2**

A. Computer and Language: students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme (3practical turns)

B. Writing Computer programme for conventional design: Students are required to write computer program and validate it for the design of machine components done in theory subject (5practical turns)

C. Mini Project: Each student will be given a real-life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

[30442]: FLUID MACHINERY LAB **L T P: 0 0 2**

Minimum 8 experiments from following

1. Impact of Jet experiment.
2. Turbine experiment on Pelton wheel.
3. Turbine experiment on Francis turbine.
4. Turbine experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through detailed visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

[30443]: REFRIGERATION & AIR CONDITIONING LAB L T P: 0 0 2

Minimum 8 experiments out of following;

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressors for determination of volumetric efficiency, PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

[4431]: COMPUTER AIDED DESIGN (CAD) **L T P: 3 1 0**

UNIT-I

Introduction: Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications

Computer Graphics-I: CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

UNIT-II

Computer Graphics-II: Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm **4**

Geometric Transformations: World/device Coordinate Representation, Windowing and clipping, 2 D Geometric Transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation **4**

UNIT-III

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models Application commands for AutoCAD & ProE software

UNIT-V

Numerical Methods: Introduction, Errors in numbers, Binary representation of numbers, Root finding Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method.

Finite Element Method: Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element)

Books & References:

1. Computer Graphics Hearn & Baker Prentice Hall of India
2.Computer Aided Engineering Design Anupam Saxena & B. Sahay Anamaya Publishers
3. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
4. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill
5. Computer Aided Design RK Srivastava Umesh Publications
6. Mathematical Elements for Computer Graphics DF Rogers & JA Adams McGraw Hill
7. Finite Element Method SS Rao
8. FE Analysis Theory and Programming CS Krishnamoorthy Tata McGraw Hill

9. Numerical Method for Engg Computation MK Jain, SRK Iyenger & RK Jain Wiley Eastern Limited
10. Computer Oriented Numerical Methods V Rajaraman Prentice Hall of India

[4432]: COMPUTER AIDED MANUFACTURING (CAM) L T P: 3 0 0

UNIT-I

Automation

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. **4**

Features of NC Machines- Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity. **3**

UNIT-II

NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro. **5**

(b) APT programming. Geometry, Motion and Additional statements, Macro-statement. **4**

UNIT-III

System Devices

Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators

Digital differential Integrator-Principle of operation, exponential decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator. **4**

Control of NC Systems: Open and closed loops. Control of point-to-point systems-Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control. **3**

UNIT-IV

Computer Integrated Manufacturing system: Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection. **6**

UNIT-V

Robotics: Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples. **6**

Intelligent Manufacturing: Introduction to Artificial Intelligence for Intelligent manufacturing. **2**

Books/References

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover
2. Computer Aided Manufacturing by Kundra and Rao
3. Computer control of Manufacturing systems by Koren
4. NC Machine Tools by S.J. Martin.
5. NC Machines by Koren
6. CAD/CAM by Groover.

L T P: 3 0 0

[4433]:AUTOMOBILE ENGINEERING

Unit-I

Power Unit and Gear Box: Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination. Design of Gear box **7**

Unit-II

Transmission System: Requirements. Clutches. Toque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer. **8**

Unit-III

Braking System: General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects **5**

Chasis and Suspension System: Loads on the frame. Strength and stiffness. Various suspension systems **3**

Unit-IV

Electrical System: ypes of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc. **5**

Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI. **4**

Unit-V

Automobile Air Conditioning: Requirements, Cooling & heating systems **2**

Cooling & Lubrication System: Different type of cooling system and lubrication system. **2**

Maintenance system: Preventive maintenance, break down maintenance and over hauling. **2**

References

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
5. Automobile Engineering - Newton and Steeds.

[40449] : CAD/CAM LAB **L T P: 0 0 2**

TEN Experiments are to carried out. FIVE Experiments each from CAD and

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feedback devices
9. Experiment on Mecatronics and controls

[40450]: AUTOMOBILE ENGG. LAB **L T P: 0 0 2**

Minimum 10 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

[4451]: POWER PLANT ENGINEERING L T P: 3 1 0

Unit-I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. **3**

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. **2**

Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. **3**

Unit-II

Steam power plant: General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of steam power plant. **8**

Unit-III

Diesel power plant: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. **2**

Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant **6**

Unit-IV

Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. **3**

Hydroelectric station: Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. **4**

Non-Conventional Power Plants: Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc **2**

Unit-V

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc. **2**

Instrumentation: Purpose, classification, selection and application, recorders and their use, listing of various control rooms. **3**

Pollution: Pollution due to power generation **2**

Books/References

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.

2. "Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.

3. “Power Plant Technology” El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

[4452]: MECHANICAL SYSTEM DESIGN **L T P: 3 0 0**

UNIT-I

Engineering process and System Approach: Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing **4**

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system **4**

UNIT-II

System Theories: System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study-automobile instrumentation panel system. **4**

System modelling: Need of modelling, Model types and purpose, linear systems, mathematical modelling, concepts, A case study compound bar system **4**

UNIT-III

Graph Modelling and Analysis: Graph Modelling and analysis process, path problem, Network flow problem, A case study: Material handling system **4**

Optimization Concepts: Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system **3**

UNIT-IV

System Evaluation: Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system **4**

Calculus Method for Optimization: Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system. **4**

UNIT-V

Decision Analysis: Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye’s theorem, A case study: Installation of machinery **4**

System Simulation: Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant **5**

Books/References

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-SS Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

[4453]: PROJECT MANAGEMENT **L T P: 3 0 0**

UNIT-I

Project Management Concepts: Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction **8**

UNIT-II

Project Organization & Project Contracts: Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors. **8**

UNIT-III

Project Appraisal & Cost Estimation: Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis. **8**

UNIT-IV

Project Planning & Scheduling: Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event-oriented networks, updating of networks, LOB technique. **8**

UNIT-V

Modification & Extensions of Network Models: Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution. Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections. **8**

Books:

1. Project Management by K. Nagarajan
2. Project Management by Harvey Maylor

ELECTIVE-1:

[4434] UNCONVENTIONAL MANUFACTURING PROCESSES L T P: 3 0 0

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes & its classification and its future possibilities. **5**

Unit-II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electrochemical machining, ultrasonic machining, Abrasive jet machining etc. **8**

Unit-III

Unconventional Machining Process (continued): Principle and working and application of unconventional machining processes such as Laser beam machining, Electron beam machining, Ultrasonic machining etc. (these can also be used for welding). **8**

Unit-IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metalizing, Plasma are welding/cutting etc **7**

Unit-V

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro Discharge forming, water hammer forming, explosive compaction etc **7**

Electronic-device Manufacturing: Brief description of Diffusion and Photo-Lithography process for electronic-device manufacturing. **3**

Books

1. Modern Machining Processes – P.C. Pandey
2. Unconventional Machining – V.K. Jain

[4435] PRODUCT DEVELOPMENT AND DESIGN **L T P: 3 0 0**

Unit-I:

Introduction to Product Design: Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology-based developments. Physical reliability & Economic feasibility of design concepts. **7**

UNIT-II

Morphology of Design: Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, colour. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist. **7**

UNIT-III

Transformations: Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis. **9**

UNIT IV

Reliability: Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. Anthropometric data and its importance in design. Applications of Computers in product design. **7**

UNIT IV

Product Appraisal: Information and literature search, patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting. **8**

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.

Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.

7. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
8. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H . Flurscheim, The

Design Council - London.

10. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.

[4436] RELIABILITY ENGINEERING **L T P: 3 0 0**

Unit-I

Introduction: Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness.

Unit-II

Reliability Mathematics: Definition of probability, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations

Unit-III

Reliability: Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tieset methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method.

Unit-III

Reliability Improvements: Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance.

Unit-IV

Reliability Testing: Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.

Books Recommended:

1. R.Billintan & R.N. Allan,"Reliability Evaluation of Engineering and Systems", Plenum Press.
2. K.C. Kapoor & L.R. Lamberson,"Reliability in Engineering and Design", John Wiely and Sons.
3. S.K. Sinha & B.K. Kale,"Life Testing and Reliability Estimation", Wiely Eastern Ltd.
4. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", McGraw Hill.
5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.

[4437] MECHANICAL VIBRATION **L T P: 3 0 0**

UNIT - I

Introduction: Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis **3**

Single Degree Freedom System: Free vibration, Natural frequency, Equivalent systems, Energy method for determining natural frequency, response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement **5**

UNIT - II

Single Degree Freedom: Forced Vibration: Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, forced vibrations with rotating and reciprocating unbalance, support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments **8**

UNIT- III

Two Degree Freedom systems: Introduction, Principal modes, Double pendulum, Torsional system with damping, coupled system, undamped dynamic vibration absorbers, Centrifugal pendulum absorbers, Dry friction damper **8**

UNIT- IV

Multi Degree Freedom system: Exact Analysis: Undamped free and forced vibrations of multi-degree freedom systems, influence number, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts **8**

UNIT- V

Multi Degree Freedom system: Numerical Analysis Rayleigh's, Dunkerely's, Holzer's ad Stodola methods, Rayleigh-Ritz method **5**

Critical speed of shafts: Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed. **3**

Books and References:

1. Mechanical Vibrations – P. Srinivasan, TMH
2. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee
3. Mechanical Vibrations – W. T. Thomson
4. Mechanical Vibrations – JS Rao & K Gupta, New Age
5. Mechanical Vibrations – Tse, Morse & Hinkle
6. Mechanical Vibrations – V. Rama Murthy, Narosa Publications

ELECTIVE-2:

[4438] OPTIMISATION TECHNIQUES IN ENGINEERING L T P: 3 0 0

Unit-I

Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions. **4**

Unit-II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn – Tucker Sufficient Conditions. **8**

Unit-III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg- Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Liner Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real-Time Optimization, Optimization in Econometrics Approaches – Blue. **10**

Unit-IV

Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Method and the Runga-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Tranzoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration Method. **10**

Unit-V

Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maximum Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods. **8**

Books.

1. Winston W L: Operations Research: Applications and Algorithms
2. Rao S.S., Optimization: Theory and Applications.
3. Walsh G R: M methods of Optimization.
4. Williams H.P.: Model Building in Mathematics Programming.
5. Williams H.P.: Model Solving in Mathematics Programming
6. G.L. Nemhauser and L.A. Wolsey: Intger and Combinational Optimization.
7. R.G. Parker and R.L. Rardin:Discrete Optimization.

[4439] TOTAL QUALITY MANAGEMENT (TQM) L T P: 3 0 0

Unit-I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type.

Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit-II

Quality Management: Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme

Human Factor in Quality: Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

Unit-III

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.

Attributes of Control Charts: Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart.

Unit-IV

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit-V

IS0-9000 and its concept of Quality Management: ISO 9000 series, Taguchi method, JIT in some details

References:

1. Lt. Gen. H.LaI, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. “Beyond Total Quality Management”. McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

[4440] PRODUCTION & OPERATIONS MANAGEMENT **L T P: 3 0 0**

Unit –I

Managing Operations: Operations Management – Function, Evolution, Definition, Systems view of P&OM; Operations Strategies for Competitive Advantage; **6**

Unit –II

Planning (Designing) the conversion System: Designing Products, Services and Processes; Operations Capacity; Locating Production and Service facilities; Layout Planning. **9**

Unit-III

Organizing the conversion System: Job design, Production and Operations standards, and work measurement; Project Management. **7**

Unit-IV

Scheduling Production and Service System: Scheduling systems, Aggregate Planning for Production and service system; Operations Scheduling. **8**

Unit-V

Material Requirements Planning: Planning for needs, applying MRP, Detailed capacity planning, MRP II. **10**

Managing for World class Competition: World class Manufacturing practices; Managing for Quality; Conversion Process in change.

Books:

1) Adam Jr Everett E. R J – Production and Operations Management (Prentice-Hall, 2000, 5th Edition)
2) Russell & Taylor III – Operations Management (Pearson, 4th Edition)
3) Hill T- Operations Management (Palgrave, 2000)
4) McGregor D – Operations Management (McGraw-Hill, 1960)
5) Morton - Production and Operations Management (Vikas)
6) Gaither & Frazier - Operations Management (Cengage Learning, 9th edition)

[4451] MAINTENANCE ENGINEERING & MANAGEMENT **L T P: 3 0 0**

Unit-I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off. **8**

Unit-II

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency. **8**

Unit-III

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure. **8**

Unit-IV

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT. **8**

Unit-V

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management. **8**

Books:

1. Management of systems – R.N. Nauhria & R. Prakash.
2. Operations Research – Wangner

ELECTIVE-3:

[4454] NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION **L T P: 3 0 0**

UNIT-I

Energy resources and their utilization: Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. **3**

Solar radiations: Extra-terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India. **4**

UNIT-II

Solar energy: Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing **2**

Solar thermal energy storage, Different systems, Solar pond. **2**

Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, **2**

solar cooking, Greenhouses, Solar power plants.

Solar photovoltaic system: Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system. **2**

UNIT-III

Biogas: Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India. **5**

Wind energy: Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development. **3**

UNIT-IV

Electrochemical effects and fuel cells: Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells. **3**

Tidal power: Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. **2**

Hydrogen Energy: Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use **3**

UNIT-5

Thermoelectric systems: Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.

Geothermal energy: Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion. **2**

Ocean energy: Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics **2**

Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy. **2**

Books / Reference:

1: Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata McGraw Hill.

2: Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.

3: Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.

4: Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.

[4455] MANAGEMENT INFORMATION SYSTEM **L T P: 3 0 0**

Unit-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS. **6**

Unit-II

Foundation of Information System: Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc **10**

Unit-III

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage. **8**

Unit-IV

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change. **6**

Reports: Various types of MIS reports, GUI & Other Presentation tools.

Unit-V

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modelling case studies. **10**

Books

1. O.Brian, “Introduction to Information System”, Mc-Graw Hill.
2. O.Brian, “Management Information System”, TMH.
3. Alter, “Information Systems: A Management Perspective”, Addison Wesley.
4. Arora & Bhatia, “Information Systems for Managers”, Excel
5. Bansal, “Information System Analysis & Design”, TMH.
6. Jawadegar, “Management Information System”, TMH.
7. Murdick, “Information System for Modern Management”, PHI.
8. Alexis Leon, “Enterprise Resource Planning”, TMH.

[4456] TRIBOLOGY **L T P: 3 0 0**

Unit-I:

Introduction to Tribology: Definition, Scope, Applications, Friction, Definition, Scope, Laws of friction. Friction theories. Surface contaminants, Effect of sliding speed on friction. **6**

Unit-II:

Wear: Definition, Scope, wear of metals, Types, Classification. Mechanism of wear, Quantitative laws. Hypothesis of Holm. Hypothesis of Burwell and Strang. Hypothesis of Archard, Rawe, Rabinowicz. Quantitative law for Abrasive wear, Bayerku surface fatigue theory. Delamination theory & Fatigue theory of wear, wear resistant materials. **10**

Introduction to wear of Polymers and Ceramics. Wear reduction by Surface Improvements, Pitting, Erosion & Stress Corrosion.

Unit-III:

Surface Interactions: Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact. **10**

Unit-IV:

Lubrication: Definition & Scope. Generalized Reynold's equation. Flow and shear stress, energy equation. Mechanism of pressure development in bearings. Concept of Boundry Layer. **5**

Unit-IV:

Bearing design considerations & characteristics: Bearing design procedure & steps. Plain slider bearing. Step (Rayleigh step) bearing. Infinitely long journal bearing. Infinitely short journal bearing. Future scope and applications. **8**

Books:

1. Engineering Tribology- Gwidon W. Stachowiak and Andrew W. Batchelor
2: Applied tribology-Michael M. Khonsari
3: Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
4: Hand Book of Tribology -- WHILEY
5: Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
6: Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.
7: Basic Lubrication theory by Alastair Cameron

[4457] FINITE ELEMENT METHOD **L T P: 3 0 0**

UNIT-I

Introduction: Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II

Types of Elements Used: Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III

Finite Element Formulation of Field Problems: 1-D and 2-D heat transfer, fluid flow (incompressible and non-viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples

UNIT-IV

Finite Element Formulation of Solid Mechanics Problems: 1-D problem of shaft; Truss element analysis of pinned truss, Plane stress/strain problems, Axi-symmetric problems, thin plate problems; Vibration of shafts & beams

UNIT-V

Numerical Methods in FEM: Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations – Gauss Elimination Method, Cholesky decomposition.

Books:

1. The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill
3. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
4. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill
5. Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
6. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
7. Finite Element and Approximation O.C. Zenkiewicy & Morgan -
8. Numerical Methods E Balagurusamy Tata McGraw Hill

ELECTIVE-4:

[4458] ADVANCED WELDING TECHNOLOGY **L T P: 3 0 0**

Unit-I

Introduction: Importance and application of welding, classification of welding process. Selection of welding process. **2**

Brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electroslag welding, Friction welding etc. Welding of MS.CI, Al, Stainless steel & Maurer/Schaefflar Diagram. Soldering & Brazing. **5**

Unit-II

Advanced welding Techniques: Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc. **7**

Unit-III

Advanced welding Techniques (continued): Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding / Metallising, Hard facing. **7**

Unit-IV

Weld Design: Welding machines/equipments and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels. Life predication. **4**

Thermal and Metallurgical consideration.: Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties. **4**

Books

Welding Hand BooK

[4459] NON-DESTRUCTIVE TESTING **L T P: 3 0 0**

Unit-1:

Introduction: Scope and advantages of NDT. Comparison of NDT with DT. Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects. **6**

Unit-2:

Common NDT methods: Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers. Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing. Zyglo test **6**

Magnetic particle Inspection: Scope, principle, Ferro Magnetic and Non-ferro magnetic materials, equipment & testing. Advantages, limitations Interpretation of results. DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications. **5**

Unit-3:

Radiographic methods: X-ray radiography principle, equipment & methodology. Applicability, types of radiations, limitations. Interpretation of Radiographs, limitations of γ-ray radiography – principle, equipment. Attenuation of electromagnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of γ-ray radiography over X-ray radiography Precautions against radiation hazards. Case Study ─ X-ray of human body. **9**

Unit-4:

Ultrasonic testing methods: Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body. **8**

Unit-5:

Eddy Current Inspection: Principle, Methods, Advantages, Scope and limitations. Types of Probes. Case Studies. **4**

Suggested References:

(1) ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation
(2) Research Techniques in NDT Vol.3, R.S. Shah, Academic
(3) Industrial Quality Control, Webstar
(4) Bray, Don E. and Stanley, Roderic K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised Edition 1997, CRC Press New York.

[4460] ADVANCED MATERIALS TECHNOLOGY **L T P: 3 0 0**

UNIT-I:

Introduction to Ferrous Materials: Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, selections, specifications, form and availability of steel. Cast irons-white, grey, modular malleable and alloy cast irons. Recognised patterns of distribution of graphite flakes in grey cast iron. **10**

UNIT-II:

Heat Treatment of Steels: TTT diagrams, annealing, normalizing, hardening and tempering of steel. Austempering and martempering of steel. Surface hardening of steel-Carbonising nitriding carbonitriding cyniding, flues and inducation hardenirng microscopic determination of case depth and depth of hardening. **5**

Unit-III:

Nonferrous materials: Ultra-light materials. Properties and application, brasses, bronzes, cupro-nickel alloys, aluminum, magnesium and titanium alloys, bearing materials. Heat treatment of nonferrous materials– soputionizing, Aging and precipitations hardening. **4**

Composites: Polymer – polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal-polymer composites. Dispersion reinforced, particle reinforced, laminated and fiber reinforced composites. **4**

Refractory materials and coatings for high temperature applications.
Smart Materials-introduction, types and applications. Thin film shape memory alloys. **2**

Unit-IV:

Biomaterials: Classes and application of materials in medicine and dentistry. Stress strain behaviour of bone. The mechanical properties including elasticity, hardness, viscoelasticity, surface and fatigue properties of skin; soft tissues; bone; metals; polymers and ceramics. Biocompatible materials and its applications. The effects of degradation and corrosion. **8**

Unit-V:

Nuclear Materials: Introduction to nuclear materials. Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials. Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers. Radiation proof materials. Brief discussion of safety and radioactive waste disposal. **7**

References:

1. Biomaterials Science- An Introduction to Materials in Medicine. Buddy D.Rattner, A.S. Hoffman, F.J. Sckoen, and J.E.L Emons, Academic Press, second edition, 2004.
2. Biomaterials: An Introduction (second edition) Joon B.Park & Roderic S.Lakes, Plenum Press, 1992.
3. Handbook of Materials for Medical Devices, Edited by J. R. Davis, ASM international, 2003.
4. Introduction to Nuclear Engineering, by J.R Lamarsh.
5. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesly Publishing Co.
6. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.

[4461] ENERGY MANAGEMENT **L T P: 3 0 0**

UNIT-I

Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Unites of energy and the laws of thermodynamics, Energy consumption and GDP, energy database, Energy demand analysis, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan. **7**

UNIT-II

Energy audit concepts, Energy audit based on 1^{st} law and 2^{nd} law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing. **7**

UNIT-III

Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Data base for energy management, Energy conservation through controls, Computer aided energy management, Program organization and methodology. **7**

UNIT-IV

Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes. **7**

UNIT-V

Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction. **7**

BOOKS:

1. Energy Management and condevtion, by Clive Beggs, Butterwoth- Heinemann Elsevier Science.
2. Optimising Energy Efficiency in the Industry, By Rajan, Tata Mc Graw Hill Publishers.
3. Guide to energy Management, By C.L Capehart, Fairmont Press.
4. Renewable Energy Sources and their Environment Impact, by Abbasi & Abbasi, Prentice Hall of India.
5. Environmental Risks and Hazards by Cutter, Prentice Hall of India.
6. Energy and Power Risk Management: New Developments in Modeling, Pricing and Hedging, buy Alexander Eydeland, John Wiley & Sons.
7. Energy Management Handbook by, Wayne C. Turner.
8. Thermodynamics, By Kenneth Wark, Tata Mc Graw Hill Publishers.
9. Exergy Analysis of Thermal, Chemical and Metallurgical Process, By Jan Szargut, David R. Morris, Frank R. Steward, Hemisphere Pub, Springer Verlag Publisher